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Contents.

(Illustrated articles are marked with an asterisk.)

THE OCEAN ECHO—HENRY VS. TYNDALL AGAIN.

Even his arduous labors in connection with the Centennial Exposition, added to his other pursuits, have not been sufficient to cause the venerable leader of American scientists to relax his researches into his favorite acoustical problems during the past year; and he recently came before the National Academy of Sciences with a new series of discoveries and theories, which he modestly announced as a "few additional facts" related to the results of his previous investigations.

It will be remembered that, at the 1875 fall meeting of the above named association, Professor Henry read a paper on a similar subject—in fact, his attention has been enlisted in the same direction for many years—in which he changed the scientific duel between Professors Tyndall and Osborne Reynolds into a triangular controversy. While he contented himself with disagreeing with Reynolds in many points, he hurled such a host of convincing experiments against Tyndall's theories of "acoustic transparency" that those structures, which Reynolds had already badly undermined, had little substantial support left them, even in the minds of those perplexed physicists who watched this war of the giants from afar, and who scarcely ventured opinions of their own in view of the disagreement of so learned a triumvirate of doctors.

Now Professor Henry returns to the fray, and again proceeds to discomfit the results of the "scientific use of the imagination" of Dr. Tyndall, not by propounding adverse theories, but by the inexorable logic of actual experiment. How he does it will appear in the following brief explanation of the new discoveries, which chiefly relate to the "ocean echo." Loud sounds, Professor Henry says, are wanting in analogy to light, so far as concerns obeying its rule that the angle of incidence is equaled by the angle of reflection. Instead of being reflected from a parabolic mirror in parallel rays, sounds diverge in all directions. A whistle being located in the focus of a parabolic reflector, 12 feet in diameter, gave a sound which, at a distance of 4 miles, had diverged so that it reached the whole horizon, and was heard with equal intensity to the rear and in front of the reflector. The cause of this divergence is explained in two ways: first, we may suppose the crest of a sound wave to be abruptly terminated at either extremity, when the tendency of the compressed air which constitutes the wave will be to expand itself in all directions—laterally from the ends of the wave as well as directly in front. Second, another cause may probably be found in the retardation of the two ends of the wave as it proceeds from the mouth of the trumpet. This would occasion a curling of the ends of the wave, as well as an elongation of them as they proceed from the swelling aperture. In the tendency of the sound to spread is to be found an explanation of the action of the trumpet, which gives the sound beam a greater condensation along its axis, and thus checks its spreading. Thus a speaking trumpet may act as efficiently if lined with felt as if lined with metal.

Although the tendency of sound is to diverge in all directions from an axis, yet there are cases where "sound shadows" are produced. Professor Henry mentioned a case where a fog whistle was placed near the water level of an island on which was a conical elevation. Vessels approaching from the other side of the hill heard the sound distinctly at a distance of three miles; but when the distance was reduced to a mile, the sound was lost and not recovered at any smaller distance. Here the termination of the shadow was at the one mile point, at which the diverging beams of sound, passing over the crest of the island, bent down and reached the surface of the water.

These conclusions are applied to the elucidation of the ocean echo, which is a reverberation coming from the horizon, near the surface of the ocean, and from around a point in the prolongation of the axis of the trumpet. It will be remembered that last year, in a lecture before the Royal Institution, Professor Tyndall adduced a number of brilliant experiments to show that echoes may be caused by reflection of sound from clouds of air of varying density. He showed, for example, that invisible warm air may act as an "acoustic cloud," and he pointed out that, "when such clouds are close to the source of sound, the echoes are immediate, and mix with the original sound; but if the acoustic clouds are further off, then there are prolonged echoes." He also showed the reflection of sound from gas flames. Professor Henry offers no objection to Dr. Tyndall's proof that a reflection of sound from a portion of air of different density is possible; but he says Tyndall's experimental conditions are exaggerated, and fail to represent any real atmospheric state. To test Tyndall's theory, he turned the mouth of a trumpet toward the zenith. The blast was intense, but no echo from the prolongation of the axis, that is, from the zenith, came back, although it was audible all around the horizon, half of which was on land and half on water. A rain cloud passed over the trumpet, and even a few drops fell: still no sound from the zenith. Compare this with Tyndall's experiment, in which he showed that, while two hundred layers of muslin did not cut off sound, a single layer, when wet, did, the latter presenting continuity of the air. Certainly it might be supposed that the rain cloud would act in a somewhat similar manner to the wet fabric. Professor Henry repeated his experiments several times, failing in each case to find any substantial basis for Dr. Tyndall's assumption On the other hand, applying his own conclusions, he considers the echo to be due to reflection from the perfectly smooth surface of the ocean. On account of the divergence of sound, portions of waves in every direction must have descended to the horizon; and as some of these must have reached the plane of the ocean in a path curving inward toward the source of sound, they would, when they reached the ear of the observer in the vicinity of the source, seem as if coming from a point in the horizon, and hence would give rise to the phenomenon of ocean echo. Rays of sound at different distances from the ear would be reflected from the surface of the ocean, and thus occasion the prolonged echo: a blast of 5 seconds in one experiment on this point gave an echo lasting 20 seconds. "This," says Professor Henry, as a final shot at the "acoustic cloud" theory, "could only be produced by ordinary reflection from a series of surfaces placed at different distances, an arrangement of the material of the atmosphere which (on the doctrine of probabilities) would not be of frequent occurrence."

SLADE SUSTAINED.

Speaking of the exposure of the Slade trick, in London a few weeks ago, we expressed the belief that it would not lessen in the least the confidence of spiritualists in Dr. Slade or his practices. Even if strong enough to secure his conviction in the courts as a common swindler, the evidence of Dr. Lankester and others could not and would not shake their assurance of his personal honesty and the genuineness of his mediumship, for the simple reason that their confidence was the result of delusion, not a sane mental condition determined by or amenable to evidence.

Whether we were right or not as to the cause, we certainly were right as to the fact, for which we have the testimony of the president of the (British) National Association of Spiritualists. At a special meeting of the association, in London, October 4, that gentleman said he would willingly speak of Dr. Slade, in compliment to whom the gathering had been announced, but that could hardly be done without being drawn into a discussion of the case before the courts, and respect for the law made such a discussion unadvisable at that time. "It may be permitted me, however," he continued, with a sublimity of faith and felicity of diction marvelous to see, "it may be permitted me, however, to state a fact, which we cannot conceal if would, that our confidence in Dr. Slade as a genuine medium is in no way affected by the inferences drawn by two gentlemen who were quite inexperienced in the difficulties of the subject, and which inferences were founded on observations likely to be unconsciously vitiated by apparently slight but really important foregone conclusions"!

Surely our venerable poet must have been in a satirical mood when he penned the familiar lines:

> "Truth crushed to earth shall rise again;
> The eternal years of God are hers:
> But error wounded writhes in pain,
> And dies amid his worshippers!"

Since the above was written Slade has been found guilty of trickery at his *séance* with Dr. Lankester, and sentenced to three months imprisonment with hard labor. From this decision, an appeal has been taken to a higher court, pending which he has been allowed to go out on bail. He was given the opportunity of performing his legerdemain in court, and of satisfying the judge of its spiritual character, but declined, not daring, apparently, to testify even in his own behalf.

THE LEVERRIER OF CHEMISTRY.

The correspondence between the hypothetical element eka-aluminum, imagined by the Russian chemist Mendeleef, and the real element gallium, recently discovered by M. Lecoq de Boisbaudran, is so remarkable that the attention of European scientists is now being closely devoted to its examination. In 1869, Mendeleef published a memoir, which attracted little notice at the time, but which announced as a law that "the properties of simple bodies, the constitution of their combinations, as well as the properties of the latter, are periodic functions of the atomic weights of the elements." Without entering into the details of the theories whence arose this conclusion, it will suffice to state that the author considers that this periodic law indicates the gaps which still exist in the system of known elements, and admits of predicting the properties of unknown elements, as well as those of their combinations. Thus, for example, there are two gaps in the groups D III and IV of the fifth series, which elements, yet to be discovered, M. Mendeleef some time ago named eka silicium (Es) and eka-aluminum (El). To show how this last mentioned hypothetical element is related to gallium, the characteristics of that metal must be reviewed.

At the present time, M. Lecoq de Boisbaudran has succeeded in preparing 7·5 grains. In a liquid state, gallium, the fusing point of which appears definitely to be 86·27° Fah., is of a fine silver whiteness; but on crystallizing, it takes a very marked bluish tint, and its brilliancy notably diminishes. By suitable cooling of the melted material, isolated crystals are obtained, in octahedral shape, and these M. de Boisbaudran is now measuring. As regards density, which is the important point to be noted, M. de Boisbaudran says: "In May, 1876, I attempted to measure the density of gallium by a specimen weighing 0·92 grain. I obtained 4·7 at 59° Fah. (and relatively to water at the same temperature). The mean of the densities of aluminum and of indium being 4·8 (to 5·1) the specific gravity provisorily found for gallium appeared to accord quite well with the theory placing that metal between indium and aluminum. The calculations established by M. Mendeleef, however, for a hypothetical body which appears to correspond with gallium, show the number 5·9. Gallium, crystallized under water, sometimes decrepitates on heating, Perhaps my first metal contained bubbles fill with air or water. To eliminate this possibility of error, I heated the metal highly and solidified it in a dry atmosphere. Then I obtained higher densities, varying from 5·5 to 6·2, the weight of the