LETTERS TO THE EDITOR.

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Tribute to Hertz.

[We have received the following two communications. In accordance with the wish expressed in the first letter, the writer's name is not given.—ED.] :—

ON page 133 of this week's number of NATURE, Prof. Oliver J. Lodge suggests "an act of tribute" to the memory of Hertz, "useful to students in this country," to which I desire to contribute *anonymously*; and I enclose my cheque for £200.

To this distinguished man the world is more indebted than has, as yet, been made known. His broad mind enabled him to conform to what Herbert Spencer has said to be the first condition of success in scientific research, viz. "an honest receptivity, and willingness to abandon all preconceived notions, however cherished, if they be found to contradict the truth."

When invited, in 1889, to witness demonstrations, declared by men of science to "demonstrate the discovery of a force previously unknown to them," he did not excuse himself on the ground of his own occupations, nor yet because he believed the man to be a charlatan. He gave over five hours to the examination of photographs of the discoverer's researching instruments; at the end of which he said that were he to go to America to witness the production of the energy, he could render no assistance; that the man must work out his system alone; and that, in order to work it out, he should not attempt to apply it to mechanics until he had obtained full knowledge of the laws of nature governing its operation.

This advice, within a period of four years, followed faithfully as it was (after nearly twenty years of work on engines), has now led to the completion of a system of vibrating physics, with entire mechanical success (it is for the assistance thus rendered that I give my tribute of gratitude); and will, in the not distant future, give to the world "the crowning achievement of an age of scientific progress," opening "the unseen highways of the air" to ships of thousands of tons burden, by the neutralising of gravity.

June 9.

SINCE writing my letter Prof. Dewar has been here, and some remarks made by him have caused me to think I can better serve the end that I have in view by another appropriation of the £200 which I offered to you for the publication of Hertz's works, although he made no suggestions, nor does he know that I have sent it.

Will you kindly hold the cheque until I gain further information, or return it to me, as you may think best?

June 10.

[The cheque has been returned to the writer.—ED.]

Bullet-Proof Shields.

I AM induced by the sight of the letter from Mr. Frederick J. Smith, in NATURE for June 7, to suggest an idea for armour-plating which occurred to me a few weeks ago, and which seems to me to offer certain advantages over Mr. Smith's proposal.

If a space were filled closely with balls of approximately the same size as the expected missile, would not the resistance be greater than that offered by either a solid plate or by Mr. Smith's cylinders, while there would be a considerable diminution of weight as compared with either?

Each ball, except those at the surface of the receptacle, would be surrounded by twelve balls, to the three of which furthest from the missile the force of the impact would pass, radiating from the ball struck at an angle of 180° . The direction thus deflected would be passed on, again at an angle of 180° , to 3×3 balls, each of which would again forward it to its three hinder-most balls.

These balls, of which there should perhaps be six layers, should be of the hardest metal available; perhaps of aluminium steel or aluminium bronze. Possibly they should be set in some soft and elastic medium that would prevent their leaking out at the hole made by the missile in the rigid covering; and, if this be not done, then a sheet of india-rubber of sufficient

thickness to close after the entry of a bullet should be placed outside the frame holding the balls.

This method seems to me to have 50 per cent. more deflecting power than that of Mr. Smith, as the cylinders would only divide the direction of the missile into two, while the spheres would divide it into three.

Whether the missile would behave like Achilles when he so unwarrantably passed the tortoise, or whether its initial line would be curled round hexagonally in every direction, as it theoretically should be, might, I think, be very simply proved by experiment.

EMMA HUBBARD.

Kew, June 10.

The Teeth and Civilisation.

IN reply to Mr. Arthur Ebbels, I can state some facts about several thousand people in the north isles of Scotland. We find here side by side old people with strong teeth free from decay, though possibly worn down like those of an old horse, and several later generations among whom dental caries is quite general, and including many girls in their teens who are almost edentulous.

No increased wear and tear of the nervous system, nor over-strain of the fifth nerve, nor increased privation can explain this extraordinary contrast. Work is if anything less arduous, clothing and other comforts more.

The habits of the older and younger generations form an equally striking contrast. The former, even as children, were thinly dressed, and did well on three meals daily. Both men and women gathered seaweed for kelp in all weathers, and worked until the tough bere bannock in their pockets became a tempting meal. It was then torn and masticated with incisors and molars doing their proper work. A drink of milk at the nearest farm completed the repast. Oatcake or oatmeal as brose or porridge served for breakfast and dinner, and home-brewed ale was a frequent beverage. Four distinctive facts can be pointed out. (1) They did not eat till they were hungry and at long intervals; (2) plenty of exercise for teeth and jaws; (3) no hot drinks; (4) they could eat without drinking. In all these points the younger generation differs. White bread is preferred, washed down with tea at 150° to 160° F. (tested with thermometer). The eat-and-swill method of eating is universal, the bolus being swept into the œsophagus without even the pretence of mastication. It is considered that not even a child can eat without a hot drink ready to its hand, and children of eighteen months may be seen drinking strong concoctions of theine and tannic acid, and refusing other food. And this usually for every meal. As school children they exist but do not thrive on this diet, but at twenty commences a divergence in the habits of the sexes. The woman, unless engaged in outdoor work, eats and swills more; the hungry ploughboy eats and masticates more, and swills less. As regards the teeth, two results are observed.

Either decay and disintegration takes place, or else the alveoli shorten until the teeth hang loose by their exposed fangs and drop out. This pseudo-senile change may happen before thirty. The incisors hardly ever suffer so much from inertia; biting is essential, but on the other hand the first impact of the semi-boiling tea is borne by them, and they often share the general ruin. Neuralgias of the fifth nerve and stomacic catarrh are exceedingly common. Oatmeal is of course almost banished from the diet of the people.

The only fallacy seems to be this: May not the old people in question be the exceptionally hardy survivors of a race equally prone to dental decay? Others must judge; but the old folk say, "I never heard much of toothache when I was young."

Sunday, May 26.

ED. JAS. WENYON.

It may be mentioned, in reply to a letter on the "Teeth and Civilisation," that this agent probably affects the health of the human teeth by the injurious nature of the food and diet she introduces in her wake. The worn-down crowns of the molar teeth of the native will correspond with the use of *grain food* and vegetable diet, mostly cold, when the silex in their constituents triturates the teeth down by degrees. But the use of *meat diets* by the civilised peoples will not affect the crown of the teeth, but tend to induce rheumatic or gouty disorders and affections of their periosteum. The most likely medium of *teeth caries*, however, being induced is the use of hot drinks, soups, tea and coffee, which primarily may cause a fissure in the enamel by unequal contraction and expansion of the structures of the teeth. Into

this fissure, on it cooling down, will be kneaded by mastication articles of irritating food and drink, which will lead to caries round it. The progress of this may *erode* a segment of the tooth, or at last penetrate into the cavity and the pulp, and lead to inflammation and abscess; and none is a more virulent agent in doing this than hot tea. The simmering kettle may be seen on the hobs of the kitchen fires in the houses of the working classes in Yorkshire and Lancashire, who are much subject to caries of the teeth and dyspepsia, in consequence of the frequent imbibition of its hot contents all day.

W. G. BLACK.

Edinburgh, May 17.

The Lowell Observatory, Arizona.

I LEARN—although I have not myself yet seen the note—that NATURE has been unwittingly led into the error of stating that Lowell Observatory, at Flagstaff, Arizona, is a branch of Harvard College Observatory. This impression had its origin in a press dispatch, and I am, with the approval of Mr. Lowell, correcting these wrong impressions when possible.

Mr. Percival Lowell—whose father is trustee of the Lowell Fund from which the cost of the Lowell Institute Lectures is defrayed—is himself an author ("Japanese Art and Customs" and a man of scientific training. He has himself worked out the plan for his observatory work, and will personally supervise and direct the investigations. His institution is one of magnitude, having 18 in. and 12 in. telescopes, and he is justly entitled to the credit. The misunderstanding seems to have arisen from the fact that he has employed two of the Harvard College Observatory assistants for the season, they having been granted leave of absence. I enclose Mr. Lowell's own statement, published yesterday, being his paper before the Boston Scientific Society, and really the first public official statement.

May 26.

JOHN RITCHIE, JUN.

[The following description is from the enclosure referred to by Mr. Ritchie. We are glad to render Mr. Lowell the credit due to him.—ED.]

The Lowell Observatory, the construction of which is now almost completed, is situated in the territory of Arizona, near the town of Flagstaff, in longitude 112° west, latitude 35° north, at an elevation of 7300 feet above the sea. Its site is thus the highest of any large observatory in the northern hemisphere, the next in point of elevation being the observatory at Denver, 5400 feet. In latitude it is furthermore the most southerly of those north of the equator. But the chief advantage hoped for from its position is in the way of atmospheric conditions, the singularly dry and clear climate of Arizona commending itself to astronomical purposes.

The observatory buildings stand upon the eastern end of a spur of high land, which rises just to the west of the town and is connected at the back some fifteen miles away with the San Francisco Mountains that reach to a height of 12,500 feet. The buildings are thus protected from the north. To the east and south they overlook the town and the plain beyond, being about 300 feet above Flagstaff and a mile away from it in an air line. The hill and the surrounding country are covered in part by a sparse growth of timber. Trees about an observatory are usually considered an advantage, as such vegetation reduces the radiation from the ground and tends to equalise the daily extremes of temperature, thus giving steadier seeing. The land for the site has very generously been given by the town, and a road to the observatory is being built by the town at its own expense.

The buildings consist of the equatorial building and of the study, placed at a short distance away from it to leeward of the prevailing winds. This disposition of the buildings is in order to minimise the risk from fire, a serious matter in so isolated a situation.

The dome of the equatorial building is constructed on a system of parallel arches, after a design by Prof. W. H. Pickering, who has made a study of domes here and abroad. It is built of a framework upon which rests a cage of wire-netting, and over this is stretched a covering of canvas. One of the chief features of the dome is its lightness. Although it is thirty-four feet in diameter, the whole revolving hemisphere weighs but two tons. Some idea of its lightness and of the ease of moving it in consequence may be got by comparing it with the dome of the large equatorial at Harvard, which, though four feet smaller, weighs fourteen tons, or seven times as much. The whole revolves on the wheels of a live-ring. The dome

was built here and, together with the pier, shipped out in pieces to Arizona. The study building will contain a general or reception room, two sleeping rooms, a photographic room and a tool-room.

The telescopic equipment consists of three telescopes of 18 inches, 12 inches and 6 inches aperture, respectively. The 18-inch glass is by Brashear, and is the largest objective Mr. Brashear has yet finished. Its focal length is 26 feet 4 inches. This is an unusually long focus, and length of focus is an advantage in an objective. It and the 12-inch one of Clark's are mounted in twin. The 18-inch will be used for usual and spectroscopic purposes, while the 12-inch will be chiefly employed photographically. The third glass, the 6-inch, is also by Clark, and is a fine objective. It has already done good work at Flagstaff by being the first of those in the northern hemisphere to catch the Gale comet the other day. Incidentally, it is a far travelled telescope, having been safely half round the world and back again before ever it started for Arizona. It is of the same size and quality as the one with which Burnham made himself the first of double-star observers. By the ingenuity of Mr. Clark it is mounted portably in equatorial, being thus rendered the largest of small telescopes, or the smallest of large ones, at pleasure.

The 18-inch has been carefully fitted by Mr. Brashear with various ingenious contrivances by Prof. Pickering for photometric and spectroscopic work. For micrometrical purposes, in addition to the micrometer proper, he has also had prepared plates minutely ruled, dotted and designed and then diminished by photography, to be introduced beside the image in the telescope, for direct comparison with the canals and lakes of Mars and other similar purposes, thus furnishing a second method for micrometrical measurement of such detail.

The Berthollet-Proust Controversy and the Law of Definite Proportions.

IN his able address at the annual meeting of the Chemical Society, the President spoke of chemical text-books somewhat scornfully. While I confess that I am not prepared to regard these books as "soul-destroying," one and all, I have long felt at least that the dogmatic exposition of the elementary laws of chemistry to which they have accustomed us is most unsatisfactory, and that a critical re-statement of first principles is much needed. To deal with the subject fully, would carry me far beyond the limits of a letter to NATURE; but it is proposed in the following communication to draw attention to certain serious misconceptions which have crept into modern text-books with regard to the Berthollet-Proust controversy and the Law of Definite Proportions, and to attempt to re-define somewhat more accurately the points which were at issue.

Berthollet, it is said in the text-books, held that the composition of a compound was not rigidly constant, while Proust showed that "the same chemical compound always consists of the same elements combined in the same proportions by weight," (a statement to be referred to later, as statement A); and this statement is regarded as an enunciation of the Law of Definite Proportions, against the acceptance of which Berthollet strove so hard. As a matter of fact it seems unlikely that Berthollet would have felt in the least inclined to contradict the statement quoted. He did not suppose for a moment that it *was* possible for two substances to exist which should be sufficiently alike in properties for them to be called the same chemical compound, and yet for these to differ sensibly in their quantitative chemical composition; yet this is what a denial of statement A amounts to. On the contrary, Berthollet, like Proust, held the opposite view, namely, that the physical properties of substances are necessarily correlated with their chemical composition, and therefore that two substances differing in their chemical composition have in general different properties and are not called by the same name. We find Berthollet making use of this view, for instance, in the course of an argument given in the "Essai de Statique Chimique," vol. i. p. 346. For he says in effect that if in certain cases we only find compounds of which the constituents are united in ratios, such as $x:y$ or $x:y_1$, among the infinite number of compounds of these constituents capable of existing, it is just because these combination-ratios correspond precisely to some physical property (*e.g.* insolubility) which renders the resulting substance easy of isolation, and takes it (to use the terminology of the time) beyond the reach of the chemical forces which caused its formation.