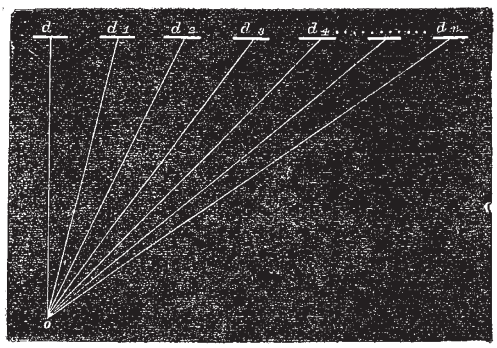
$\sqrt{D^2 + 9\delta^2}$; the reflected sounds which reach the observer will travel double those distances.

$D\,(D^2 + \delta^2)\,(D^2 + 4\delta^2)$ &c., being integral quantities, and δ positive, the series will be an increasing one; hence the first impulse which is heard is that produced by d, and the last one that by d_n.



Twice the difference between any term and that which immediately precedes it will be the length of the sound-wave corresponding to that term, and the velocity of sound per second, divided by the wave-lengths, gives the relative pitches of the different impulses.

The wave-lengths corresponding to $d\,d_1\,d_2$ &c. are—

$$2(\sqrt{D^2 + \delta^2} - D);\ 2(\sqrt{D^2 + 4\delta^2} - \sqrt{D^2 + \delta^2});$$
$$2(\sqrt{D^2 + 9\delta^2} - \sqrt{D^2 + 4\delta^2}) \text{ &c.} \qquad (1.)$$

And calling V the velocity of sound per second, we get the relative pitches—

$$\frac{V}{2(\sqrt{D^2 + \delta^2} - D)};\ \frac{V}{2(\sqrt{D^2 + 4\delta^2} - \sqrt{D^2 + \delta^2})} \text{ &c.}$$

Now, if the observer removes close up to the fence, the distance D becomes an indefinitely small quantity, or zero, and the series (1) for the wave-lengths becomes $2\sqrt{\delta^2}$; $2(2\sqrt{\delta^2} - \sqrt{\delta^2})$; $2(3\sqrt{\delta^2} - 2\sqrt{\delta^2})$; $2(4\sqrt{\delta^2} - 3\sqrt{\delta^2})$, &c., or 2δ, 2δ, 2δ, &c.; that is, the wave-lengths are all equal, and a musical sound is heard. In practice, an ordinary fence does not yield a sufficiently loud note to be easily heard in this case, but one made with posts having intervening spaces of about five inches gives a good result when one stands four or five feet from it, the note comes out almost perfect. By taking different values for D we have from series (1) a corresponding change of wave-lengths, so that if a row of persons are placed from o to d, each will hear a sound which is different in pitch from that heard by all the others.

It is perhaps needful to state that the sound which has been described is completely masked if there are houses or a wall a few feet behind it, or if the place of observation is a road fenced with palisades on both sides, two sounds are produced which interfere and confuse each other.

Glasgow ANDREW FRENCH

The Degeneracy of Man

THE numbers of NATURE for June and July last, which have lately reached me (vol. x. pp. 146, 164, 204 and 205), contain a correspondence on the subject of the degeneracy of man, in connection with which I wish to contribute a few remarks.

I have nothing to say on the original point introduced by Mr. E. B. Tylor. But, during my residence in the islands of the Pacific, I have given some attention to the general question of degradation or progression, as exhibited in the Polynesians. The result is, that I believe there are numerous indications of the degeneracy of these people from a higher social and intellectual level than that which they at present occupy. I could not give in detail, in this letter, the entire evidence on which this opinion is based; I will therefore briefly mention two or three indications only of this degeneracy which I have noticed.

The language of the Polynesians furnishes one of these. While there is much in it which shows a low moral tone, there are, on the other hand, many refinements (a large proportion of which are known to most of the present generation) which I do not believe could have been invented, or gradually developed, by the race in its present intellectual condition. Their old traditional stories, and their ancient poetry also, are so different from anything the present Polynesians are capable of producing, that I often think (your classical readers will please pardon the comparison) the relative difference, between the past and present, is as great as that between the intellect of the Greeks, in the period of the highest Attic culture, and those of the present century. I have often asked men of more than average intelligence, why their modern compositions are so inferior to many of the old ones. They invariably reply that the men of old were greater and wiser than those of the later generations.

The industrial and ornamental works of the Polynesians are all, I believe, of ancient origin. Their houses, their canoes (with one exception), their fine mats, the way in which they make their bark cloth, and even the patterns which they print on it, are all according to the traditional forms handed down from generation to generation. There is no originality. Invention is unthought of. Even now, when the influence of external civilisation is brought to bear with considerable force upon them, they adopt a new idea very, very slowly. If they had never been in a higher and more active intellectual condition, I cannot conceive how they could possibly have obtained the many comparatively excellent customs, the—in many respects—elaborate language, and the advanced social customs which were in their possession when first they became known to the civilised world.

I am well aware that absolute proof of the degeneracy of the Polynesians will not, by any means, render necessary the conclusion that degeneracy has been universal with the human race. Advocates of the progressive theory do not deny that some instances of degradation are to be found. In his "Primitive Culture" (vol. i. p. 34) Mr. Tylor says: "Of course the progression-theory recognises degradation, and the degradation-theory recognises progression, as powerful influences in the course of culture." Hence I present the indications of degeneracy above-mentioned as, at most, only a minute portion of the cumulative evidence which must be adduced indisputably to prove the degradation-theory of general application to the human race.

Apropos of this question I may add, that I often think much of the difference between (at least the more moderate) progressionists and degradationists is owing to the want of a clear definition of the term *civilisation* as used on either side. One appears to me to think chiefly of a *material civilisation*, while the other thinks mainly of a *moral civilisation*. I do not believe in the evolution of man from a lower form of life. But, notwithstanding this, I doubt whether the first man was *civilised* in the ordinary sense in which that word is now used. So far as a material civilisation goes, I take him to have belonged to the earliest stone age. But at the same time I feel the strongest conviction that he was, in point of moral civilisation, immeasurably in advance of a savage. It has often been said by advocates of the degradation-theory that no well-authenticated instance has ever been given of a savage who has, apart from external help, improved his condition. I believe this assertion to be true, notwithstanding Sir John Lubbock's "Cases in which some improvement does appear to have taken place," given in the appendix to his "Origin of Civilisation" (pp. 376-380). I do not deny the force of the reply to the above assertion, given by advocates of the progression-theory; viz., that it is almost impossible to *prove* that a savage race has, unaided by external influence, bettered its condition. But from personal observation of savage and semi-savage life, I feel almost certain that a real savage is utterly incapable of, in any way, raising himself. He lacks the sensibility which must serve as a fulcrum for the lever which is to lift him. Upon this ground alone, if I had no other reason for it, I should doubt whether man had, unaided, developed himself from a state of unmitigated savagery.

Upolu, Samoa S. J. WHITMEE

The Law of Muscular Action

IN NATURE vol. xi. p. 426, my esteemed friend Prof. Hinrichs does me the honour to comment on my paper published in NATURE, vol. xi. pp. 256 and 276.

He claims to have found that in lifting a weight w until exhaustion sets in, the number of lifts n is represented by the equation—

$$\left.\begin{aligned} n &= \frac{A}{B^w} \\ \text{or} \qquad \log. n &= \log. A - w \log. B_1 \end{aligned}\right\} \qquad (1)$$

where A and B are constants.

That the relation between n and w (the strength of the muscle