

never responded to the challenge, I maintain that he has no right in a scientific discussion to reiterate a statement in support of which he has produced no definite observed evidence. He now returns the challenge to me. But it is no affair of mine. I simply take note of the fact that Prof. Lankester pointed out that the Duke's case collapsed unless the challenge was met, and that the Duke acquiesced by silence.

Just, however, as with the question of acquired characters, the Duke in defect of direct evidence now tries an *a priori* argument. He reminds us of the well known principle of embryology, sometimes called the recapitulation theory. Darwin states it in this form: the embryo is "a picture, more or less obscured, of the progenitor, either in its adult or larval state, of all the members of the same great class."

Now, of course, in the development of the individual organism, we have "a series of incipient structures on the rise for actual use," if by "on the rise" we mean in process of nutritive growth. This is, however, not necessarily true of the recapitulative structures which may or may not be temporarily utilized. When they are not so utilized they are mere survivals, and we know that survivals constantly so completely fall out of use, that by mere inspection it is often difficult to conceive what could have been their original function. I may give a single illustration. In flowering plants the homologue of the spore of the vascular cryptogams is still preserved. *Within* it, previous to fertilization, certain rudimentary structures are developed. It has been shown that these are the last recapitulative remnant of an independent series of structures developed *outside* the spore in the fern. In that type they form the prothallus, which possesses all the attributes of an independent organism, assimilates, respire, often reproduces itself asexually, and finally bears the sexual reproductive organs. All this in the flowering plant is not merely reduced to scarcely intelligible rudiments, but, in accordance with a well-known principle in embryology, it is thrown backwards in the order of development, and never emerges from the spore at all, instead of as in the fern being wholly external to and independent of it.

In this case we know the recapitulation and the thing recapitulated. We infer from their comparison that a fern-like plant was amongst the ancestry of the flowering plant. But I defy anyone, from a mere inspection of what happens in the latter, to form any idea of what happens in the former. From cases such as these it is obvious that the analogy between the development of the individual and the evolution of the race only holds for the broad facts of the sequence of stages, and does not give us any information as to the inutilty of the structures of the ancestral organisms, or even, indeed, as to the precise period in their life when such structures made their appearance. The Duke's argument may now, I take it, be stated as follows:—

In the development of the individual organism, incipient organs are useless.

The development of the individual organism is a recapitulation of the evolution of the race.

∴ Incipient organs in the evolution of the race are useless.

I observe that the Duke's estimation of my logical powers is the reverse of flattering. I abstain, therefore, from criticizing this piece of reasoning. For my part I must confess I do not possess an *a priori* mind. No argument, however ingenious, is as convincing to me as accurately observed facts. If the Duke's convictions are laws of Nature, the objective verification ought to be forthcoming.

W. T. THISELTON DYER.

Royal Gardens, Kew.

THE Duke of Argyll supports his assertion that "all organs do actually pass through rudimentary stages in which actual use is impossible" by reference to the stages of embryonic growth. Surely the assertion remains merely an empty repetition of the Darwinian position that the development of the embryo summarizes the morphological history of the race.

The modern dress coat has developed from a mere blanket, but even the useless parts of the modern coat can be easily shown to have had their use in some anterior forms of completed coat. The embryo, like the coat, preserves traces of evolutionary stages at which what now appear useless characters were in reality actual useful characters.

What the Duke has to show is some instance of a completed organ in a completed organism, useless to that organism, not phases in the growth of an organ affording a blurred copy of some form of the organ existent at an anterior stage of the organism, and then useful to it. So far he has merely

confounded ontogenal steps of growth with phylogenal phases of plan.

F. V. DICKINS.

Burlington Gardens, February 3.

### Eight Rainbows seen at the Same Time.

THE following letter which I have just received from Dr. Percival Frost of Cambridge, may interest your readers.

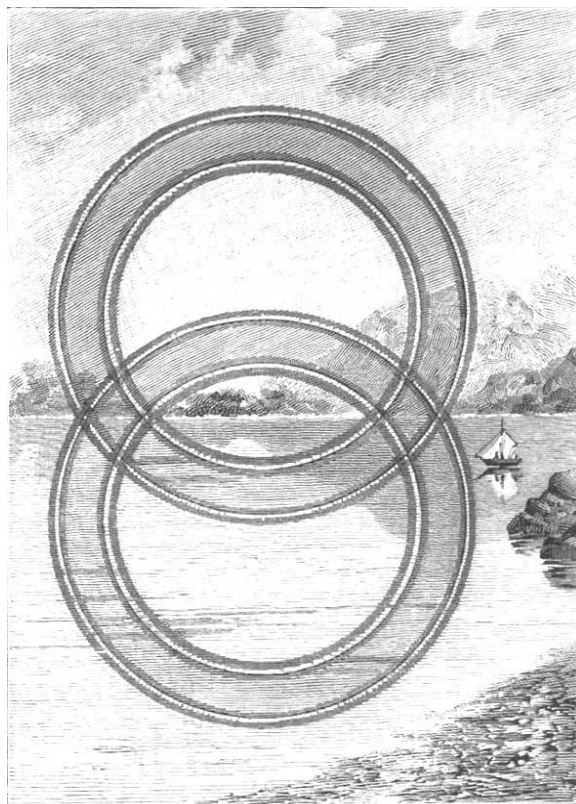
A statement that rainbows are produced not only by the sun itself directly, but by the image of the sun reflected from still water, is given in Prof. Tait's book on "Light." The phenomenon seems to have been observed by Halley in 1698 (see NATURE, vol. x. pp. 437, 460, and 483 for interesting correspondence on the subject).

The diffuse rainbow produced by the image of the sun reflected from a white cloud after sunset, described by Mr. Scouller, is, I believe, a novelty.

WILLIAM THOMSON.

The University, Glasgow, January 31.

IN NATURE (January 23, p. 271) you give a letter from Mr. Scouller describing an interesting case of a rainbow, due to the image of the sun in water, which, with the ordinary, primary, and secondary bows, make up (there being no secondary to that formed by the reflected sun) the *three* which he saw. Here is a short account of what I saw long ago, almost in prehistoric times, in Scotland, where such sights ought, according to your correspondent, to be very commonly seen. I may mention that I saw at the same time, lasting some five minutes, *eight* well-defined rainbows of one sort or another.



In 1841, during the time of a long vacation party, spent at Oban, I walked out with my brother to Dunstaffnage, and we were on the top of the Castle, somewhere between 3 and 4 p.m., on a day in the middle of August. Not a breath of wind, bright sun over, I think, Lismore Lighthouse, dusky clouds all over Ben Cruachan and Conoll Ferry; the sea in the bay (bounded by Dunstaffnage in the west) as smooth as a pond. Gradually there appeared before us the astonishing sight of the aforesaid *eight* distinct rainbows, viz. primary and secondary ordinary bows; primary and secondary bows by reflected sun; primary and

secondary bows formed by light from the real sun reflected from the water after leaving certain drops; primary and secondary formed by light from the sun reflected at the water, and, after leaving certain other drops, again reflected at the water. I have called the latter four distinct bows, because, although they looked like reflections of a solid set of four arcs, they were really formed by means of drops distinct from those which helped to make the first four bows. I append a sketch of what I saw.

PERCIVAL FROST.

15 Fitzwilliam Street, January 29.

[We have received other letters on the subject of Mr. Scouller's letter.]

### Thought and Breathing.

I SEND you some extracts from the Sanskrit Yoga-sūtras which treat very fully of the *prāṇāyāma*, or the expulsion and retention of breath, as a means of steadying the mind.

A Yogi has first of all to assume certain postures which help him to fix his mind on certain objects. He cannot concentrate his mind while walking or running. He ought to assume a firm and pleasant position, one requiring little effort. To judge, however, from the description given of some of these postures, they would seem to us anything but pleasant.

When a Yogi has accustomed himself to his posture, he begins to regulate his breath—that is, he draws in the breath through one nostril, retains it for some time in the chest, and then emits it through the other nostril. The details of this process are given in the first chapter of the Yoga-sūtras, sūtra 37. Here the commentator states that the expulsion means the throwing out of the air from the lungs in a fixed quantity through a special effort. Retention is the restraint or stoppage of the motion of breath for a certain limited time. That stoppage is effected by two acts—by filling the lungs with external air, and by retaining therein the inhaled air. Thus the threefold *prāṇāyāma*, including the three acts of expiration, inspiration, and retention of breath, fixes the thinking principle to one point of concentration. All the functions of the organs being preceded by that of the breath—there being always a correlation between breath and mind in their respective functions—the breath, when overcome by stopping all the functions of the organs, effects the concentration of the thinking principle to one object.

Rājendralal Mitra, to whom we owe a very valuable edition of the text and translation of the Yoga-sūtras, adds the following remarks:—"All other Yogic and Tantric works regard the three acts of expiration, inspiration, and retention performed in specific order to constitute *prāṇāyāma*. The order, however, is not always the same. . . . The mode of reckoning the time to be devoted to each act is regulated in one of two ways: (1) by so many repetitions of the syllable om, or the mystic mantra (formula) of the performer, or the specific mystic syllables (*vija*) of that mantra; (2) by turning the thumb and the index-finger of the left hand round the left knee a given number of times. The time devoted to inspiration is the shortest, and to retention the longest. A Vaishṇava in his ordinary daily prayer repeats the *Vija*-mantra once while expiring, 7 times while inspiring, and 20 times while retaining. A Śākta repeats the mantra 16 times while inspiring, 64 times while retaining, and 32 times while expiring. These periods are frequently modified."

The usual mode of performing the *prāṇāyāma* is, after assuming the posture prescribed, to place the ring-finger of the right hand on the left nostril, pressing it so as to close it, and to expire with the right, then to press the right nostril with the thumb, and to inspire through the left nostril, and then to close the two nostrils with the ring finger and the thumb, and to stop all breathing. The order is reversed in the next operation, and in the third act the first form is required. The *Haṭhādikā* says:—"By the motion of the breath, the thinking principle moves; when that motion is stopped, it becomes motionless, and the Yogi becomes firm as the trunk of a tree; therefore the wind should be stopped. As long as the breath remains in the body, so long it is called living. Death is the exit of that breath, therefore it should be stopped."

Some of the minor works on Yoga expatiate on the sanitary and therapeutic advantages of practising *prāṇāyāma* regularly at stated times. In America some spiritualistic doctors prescribe the same practice for curing diseases.

In India *prāṇāyāma* is only a means towards a higher object—namely, the abstraction of the organs from their natural functions. It is a preliminary to Yoga, which consists in *dhāraṇā*, stead-

fastness, *dhyāna*, contemplation, and *samādhi*, meditation, or almost a cataleptic trance. These three are supposed to impart powers or *siddhis* which seem to us incredible, but which nevertheless are attested by the ancient Yogis in a very *bonâ-fide* spirit, and deserve examination, if only as instances of human credulity. I say nothing of modern impostures.

Oxford, January 22.

F. MAX MÜLLER.

IN connection with Prof. Leumann's recent researches into the relation between changes in respiration and changes in certain cerebral functions, it seems curious that the employment of deep and rapid respiration as an anæsthetic has received so little attention. Some dentists order their patients to respire as quickly and fully as they can for a period which varies, I believe, from four to six minutes, although as to the exact duration I am insufficiently informed. At the termination of this period the patient becomes giddy, and to a great extent loses consciousness, when a short operation can be painlessly performed. The patient, while unable to move his arms, opens his mouth at the order of the operator. I have heard of no casualties or evil effects from this mode of treatment.

W. CLEMENT LEY.

### Chiff-Chaff singing in September.

DURING more than forty years' observation of the singing of birds, I have invariably heard the chiff-chaff singing in September, although the song is much less frequently repeated than in the spring. In connection with this observation I may mention that both the male and female birds appear to be always mute for two or three days after their spring arrival in Northern Europe.

W. CLEMENT LEY.

Lutterworth, January 31.

### Foreign Substances attached to Crabs.

I HAVE read in recent numbers of NATURE some letters on sponges attached to crabs.

There are two crabs on the east coast of Australia—one of them allied to *Dromia vulgaris*—which cover themselves with sponges or with a composite Ascidian. I have in one case counted no less than seven species of sponges on one individual crab.

The Ascidian referred to is usually from ten to thirty times as large as the crab to the back of which it is attached.

Among the specimens brought by me from Australia, and now deposited in the National Collection of the British Museum, there are some of these crabs with sponges and Ascidians attached.

These might, perhaps, be interesting to your correspondents on the subject.

R. V. LENDENFELD.

University, Innsbruck, January 25.

### Foot-Pounds.

"A. S. E." will find moments, of resistance, of bending, or of turning, expressed in foot-pounds (often inch-pounds or foot-tons) in any treatise on civil, mechanical, or marine engineering, on architecture, land or naval, and, in fact, in every treatise on *real* mechanics he may consult. Why, then, should a different terminology be adopted in a Civil Service examination paper? In metric units, moments are given in kilogramme-metres or centimetres; but in the C.G.S. system I do not suppose it is suggested to measure moments of dyne-centimetres in ergs.

February 3.

A. G. GREENHILL.

If "A. S. E." will push his researches further, he will find that in Government dockyards the stability moment on ships is calculated in foot-tons.

February 3.

V.

### PROF. WEISMANN'S THEORY OF HEREDITY.

IN NATURE of October 24, 1889 (p. 621), appeared a criticism by Prof. Vines of my essays on heredity and allied subjects. I should be glad to reply briefly to his objections, and the more so as I hope thus to be able to place the scientific problems at issue in a somewhat