each element has a definite combining power or equivalence, and that the arrangement of atoms in compounds is of as much importance as their kind or number. This work is remarkable for the conciseness of its definitions; one of the first is on chemical and physical changes, in which it is said that "physical changes in matter are those which take place outside the molecule; they do not affect the molecule itself, and therefore do not alter the identity of the matter operated on. Chemical changes take place within the molecule, and hence cause a change in the matter itself." Some of the definitions would not, however, find general acceptance; thus, an acid molecule is said to be "one which consists of one or more negative atoms united by oxygen to hydrogen;"—a definition which excludes hydrochloric acid and its analogues. And a saline molecule is defined to be one containing a "positive atom or group of atoms, united by oxygen to a negative atom or group of atoms," which removes sodic chloride from the list of salts. The term base is confined to the hydrates of positive elements or groups of elements, and the hydrates of the metals calcium, zinc, and iron are sometimes called calcic base, zincic base, ferrous base, and ferric base. The nomenclature of the acids is systematised, but peculiar names are the result: an ortho-acid is one containing as many atoms of oxygen and hydrogen as is equal to the equivalence of the negative atom or group; and a meta-acid is derived from an ortho-acid by the subtraction of molecules of water, thus ortho-phosphoric acid would be $P(OH)_5$, metaphosphoric acid $(PO)'''(OH)_3$, and dimetaphosphoric acid $(PO_2)'(OH)$. These names and those of most other acids are liable to some misunderstanding, as the compounds they represent have long been known by other designations. The theoretical part of the book contains chapters on elemental molecules and atoms, compound molecules, volume relations of molecules, and stoichiometry. The part on inorganic chemistry is divided into eleven chapters, on hydrogen, the negative monads, dyads, triads, boron, negative tetrads, the iron group, positive tetrads, triads, dyads and monads, thus treating of the elements according to their electro-chemical characters, commencing with the most negative. Each chapter is divided into sections containing the history, occurrence, preparation, and properties of the elements, and is followed by a series of questions intended as exercises for the students, a method now much adopted, and found to be of great assistance to teachers. This book is another of the evidences of the rapid progress of pure science in America.

Czermak's Electric Double Lever. (*Der Electrische Doppelhebel, von J. N. Czermak*) (Leipzig: Engelmann. 1871. London: Williams and Norgate.)

A DESCRIPTION of a most ingenious little contrivance for marking the exact moment in which a movement begins or changes its direction. The old arrangement, by which a lever, forming part of a circuit, comes, when set in motion, in contact with a fixed point connected with the other part of the same circuit, and so closes the circuit and makes a signal, is modified by Prof. Czermak as follows. The fixed contact point is replaced by a secondary lever, whose axis of revolution is the same as that of the primary lever. This secondary lever bears at one end a contact point. The primary lever touches in its swing this contact point, and so closes the circuit; it then pushes the secondary lever before it, but having reached the limit of its oscillation, leaves the secondary lever at rest in a position marking the farthest point of the excursion. A counter contact-point, however, on the other arm of the primary lever (where the lever is a double-arm one; with single arm levers, a special arrangement is introduced), as the primary lever is returning into position gives to the secondary lever a movement in the same direction. Thus the two levers are continually following each other, making and breaking contact. The instrument is in this way made capable of being used for signalling all manner of movements. It is impossible fully to explain its construction in a few lines, and we therefore refer the reader to the pamphlet itself, which, we should say, is published in celebration of the Jubilee of the great Leipzig Professor, Ernst Heinrich Weber. By the invention of his delightful "Rabbit Holder," Czermak has endeared himself to every physiologist, and we may well share his hope that this new double lever will be found no less useful. M. FOSTER

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his Correspondents. No notice is taken of anonymous communications.*]

Pangenesis

IT appears from Mr. Darwin's letter to you in last week's NATURE,* that the views contradicted by my experiments, published in the recent number of the "Proceedings of the Royal Society," differ from those he entertained. Nevertheless, I think they are what his published account of Pangenesis (Animals, &c., under Domestication, ii. 374, 379) are most likely to convey to the mind of a reader. The ambiguity is due to an inappropriate use of three separate words in the only two sentences which imply (for there are none which tell us anything definite about) the *habitat* of the Pangenetic gemmules; the words are "circulate," "freely," and "diffused." The proper meaning of circulation is evident enough—it is a re-entering movement. Nothing can justly be said to circulate which does not return, after a while, to a former position. In a circulating library, books return and are re-issued. Coin is said to circulate, because it comes back into the same hands in the interchange of business. A story circulates, when a person hears it repeated over and over again in society. Blood has an undoubted claim to be called a circulating fluid, and when that phrase is used, blood is always meant. I understood Mr. Darwin to speak of blood when he used the phrases "circulating freely," and "the steady circulation of fluids," especially as the other words "freely" and "diffusion" encouraged the idea. But it now seems that by circulation he meant "dispersion," which is a totally different conception. Probably he used the word with some allusion to the fact of the dispersion having been carried on by eddying, not necessarily circulating, currents. Next, as to the word "freely." Mr. Darwin says in his letter that he supposes the gemmules to pass through the solid walls of the tissues and cells; this is incompatible with the phrase "circulate freely." Freely means "without retardation;" as we might say that small fish can swim freely through the larger meshes of a net; now, it is impossible to suppose gemmules to pass through solid tissue without *any* retardation. "Freely" would be strictly applicable to gemmules drifting along with the stream of the blood, and it was in that sense I interpreted it. Lastly, I find fault with the use of the word "diffused," which applies to movement in or with fluids, and is inappropriate to the action I have just described of solid boring its way through solid. If Mr. Darwin had given in his work an additional paragraph or two to a description of the whereabouts of the gemmules which, I must remark, is a cardinal point of his theory, my misapprehension of his meaning could hardly have occurred without more hesitancy than I experienced, but I certainly felt and endeavoured to express in my memoir some shade of doubt; as in the phrase, p. 404, "that the doctrine of Pangenesis, pure and simple, as I have interpreted it, is incorrect."

As I now understand Mr. Darwin's meaning, the first passage (ii. 374), which misled me, and which stands: " . . . minute granules . . . which circulate freely throughout the system" should be understood as "minute granules . . . which are dispersed thoroughly and are in continual movement throughout the system;" and the second passage (ii. 379), which now stands: "The gemmules in each organism must be thoroughly diffused; nor does this seem improbable, considering . . . the steady circulation of fluids throughout the body," should be understood as follows: "The gemmules in each organism must be dispersed all over it, in thorough intermixture; nor does this seem improbable, considering . . . the steady circulation of the blood, the continuous movement, and the ready diffusion of other fluids,

* NATURE, vol. iii. p. 502.

and the fact that the contents of each pollen grain have to pass through the coats, both of the pollen tube and of the embryonic sack." (I extract these latter *addenda* from Mr. Darwin's letter.)

I do not much complain of having been sent on a false quest by ambiguous language, for I know how conscientious Mr. Darwin is in all he writes, how difficult it is to put thoughts into accurate speech, and, again, how words have conveyed false impressions on the simplest matters from the earliest times. Nay, even in that idyllic scene which Mr. Darwin has sketched of the first invention of language, awkward blunders must of necessity have often occurred. I refer to the passage in which he supposes some unusually wise, ape-like animal to have first thought of imitating the growl of a beast of prey so as to indicate to his fellow monkeys the nature of expected danger. For my part, I feel as if I had just been assisting at such a scene. As if, having heard my trusted leader utter a cry, not particularly well articulated, but to my ears more like that of a hyena than any other animal, and seeing none of my companions stir a step, I had, like a loyal member of the flock, dashed down a path of which I had happily caught sight, into the plain below, followed by the approving nods and kindly grunts of my wise and most-respected chief. And I now feel, after returning from my hard expedition, full of information that the suspected danger was a mistake, for there was no sign of a hyena anywhere in the neighbourhood. I am given to understand for the first time that my leader's cry had no reference to a hyena down in the plain, but to a leopard somewhere up in the trees; his throat had been a little out of order—that was all. Well, my labour has not been in vain; it is something to have established the fact that there are no hyenas in the plain, and I think I see my way to a good position for a look out for leopards among the branches of the trees. In the meantime, *Vive* Pangenesis.

FRANCIS GALTON

The Hylobates Ape and Mankind

THE readers of Mr. Mivart's communication in NATURE for April 20, on the affinity of the Hylobates genus of ape to the human species, may be interested to learn that the fact was well known to the author of the Ramayana, the earliest Sanscrit epic, probably contemporaneous with the Iliad. In this poem the demigod Rama subdues the demon Ravana, and regains his ravished bride Sita by the assistance of a host of apes, which may be identified with *Hylobates Hoolook*. The human characteristics of these semi-apes, their gentleness, affection, good humour, sagacity, self-importance, impressionability, and proneness to melancholy, are portrayed with the most vivid strokes, and evidently from careful observation. See Miss Frederika Richardson's charming volume, "The Iliad of the East," a selection of legends drawn from the Ramayana. (Macmillan and Co., 1870.)

R. G.

April 27

Tables of Prime Numbers

WHEN a number is given, and it is required, without the aid of tables, to find its factors, there is not, I believe, any other method known except the simple but laborious one of dividing it by every odd number until one is found that measures it, and if the number should be prime, this can only be proved by showing that it is not divisible by any odd number less than its square root. Thus to prove that 6966007 is prime, it would be necessary to divide it by every odd number less than 2639, and even if a table of primes less than 2639 were at hand, about 380 divisions would be requisite.

On the other hand, there are few tables which are more easily constructed than tables of divisors, and it is the extreme facility of a systematic tabulation compared to the labour of isolated determinations, which has led to the construction of such elaborate tables on the subject as have been produced.

The principal tables are Chernac's, which give the factors of numbers from unity to a million; Burckhardt's, which extend as far as three millions, and Dase's, which form a continuation of Burckhardt's, and extend to ten millions.

The mode of formation of these tables was extremely simple. By successive additions, the multiples of 3, 5, 7, 11, 13, 17 . . . were formed up to the limit to which the table was intended to extend; this gave all the numbers having these numbers for factors, and the primes were recognised from the fact of their not occurring as multiples of another prime less than themselves.

Practically the work was rendered even simpler by mechanical means; thus, forms were printed containing, say, a thousand squares, and in these were written consecutive thousands of odd numbers in order; one number in each square, room being left for its divisors, if any, in the square. A pair of compasses was then taken and opened a distance corresponding to the prime whose multiples were to be obtained; for example, in marking the multiples of seven, the compasses were opened the width of seven squares, and then "stepped" along the lines starting from 7, thereby marking the numbers 7, 21, 35 . . . and the number 7 was written in each of the squares in which a leg of the compasses fell. When the factor was large it was more convenient to form a separate table of its multiples, and enter it in the square corresponding to the latter. Many simplifications were introduced in the details of the construction; for instance, Burckhardt had a copper plate engraved with 77 (=7 × 11) squares one way and 80 the other; by this arrangement the multiples of 7 and 11, which were of the most frequent occurrence (for all multiples of 2, 3, and 5 were rejected from the tables), occupied the same place on each sheet, and he was thus enabled to engrave the numbers 7 and 11 on the plate, so that these numbers were *printed* in all the squares containing the numbers they measured.

Dase, who originally applied himself to the construction of the tables at the suggestion of Gauss, left behind him in manuscript at the time of his death, in 1862, the seventh and part of the eighth million complete, besides a considerable portion of the ninth and tenth millions. The seventh, eighth, and ninth millions were completed by Dr. Rosenberg, and published by a committee at Hamburgh. In the preface to the ninth million (1865), which is the last I have seen, it is stated that the tenth million, which was nearly ready, was the last the committee intended to publish.

My object in writing this letter is not only to call attention to a most valuable series of tables, which seem to have scarcely excited so much interest as they deserve, but also to ask if any of your readers can inform me if the work is being continued, or if there is any chance of its continuation. It is not often that tables are so indispensable as in the present case, or that a want so pressing can be supplied with such comparative ease; and the cessation of the tables would be a real calamity. The tenth million has, I presume, been published.

At the British Association Meeting at Dundee in 1867, a list of 5,500 large prime numbers was communicated to Section A by Mr. Barrett Davis. A short discussion took place on the "reading" of the paper, in the course of which it was stated that Mr. Davis's table was unaccompanied by any explanation of how the numbers had been obtained, or on what grounds they were asserted to be prime; it was also asserted that Mr. Davis wished to keep his method secret.

Perhaps some reader of NATURE can say whether Mr. Davis's numbers have been printed. If they exceed Dase's limit, their publication (if they have not yet been published) is very desirable; and even supposing they are given in Dase's tables, it would be valuable to know how far the latter have been verified by them. The statement about Mr. Davis's method being secret was probably founded on some mistake, and no doubt Mr. Davis would not object to explain it.

J. W. L. GLAISHER

Trinity College, Cambridge, April 29

Units of Force and Energy

THE best root for the name of a unit of force is δύναμις. There is, therefore, no ground for Mr. Muir's complaint (NATURE, vol. iii. p. 426), and I now venture to propose that the name *dyne* be given to that force which, acting on a gramme for a second, generates a velocity of a metre per second. A thousand dynes [illegible] to make one *kilodyne*, and a million dynes one *megadyne*.

Borrowing a hint from Mr. Muir, I would point out that the kilodyne may also be defined as the force which, acting on a *kilogramme* for a second, generates the velocity of a *metre* per second, or, as the force which, acting on a *gramme* for a second, generates a velocity of a *kilometre* per second.

The *kinit*, or pound-foot-second unit of force, is about [illegible] dynes. Very roughly expressed in terrestrial gravitation measure, the kinit is the gravitating force of half an ounce, the [illegible] of about $1\frac{1}{2}$ grains, the kilodyne of about $\frac{1}{4}$ of a pound, and the megadyne of 2 cwt., the approximation being much closer in the last case than in the others, so that within one part in [illegible] have 10 megadynes = the force of terrestrial gravity on a ton.

I have often felt the want of a name for an absolute unit of energy, or, what amounts to the same thing, an absolute unit