atoms are supposed to form closed chains. Objections have sometimes been raised against this division as somewhat arbitrary; but we cannot help thinking that it is justified by the peculiar kind of isomerism, depending on the relative position or "orientation" of the substituted groups or radicals which exists amongst benzene derivatives.

The formation, constitution, and general properties of the Paraffins are next explained, together with those of the several groups of bodies, Alcohols, Acids, Amines, &c., derived from them by substitution, and the remainder of the volume is devoted to the special description of these several compounds, which are arranged according to the number of carbon-atoms contained in them, beginning with the lowest or Methyl-group, the fundamental hydrocarbon or paraffin of each group being first described, and then in succession the Alcohols, Ethers, Nitrogen-bases, Phosphorus-bases, Organo-metallic compounds, Aldehydes, Acids, Ketones, Sulphur-compounds, &c., derived from it.

All these compounds are clearly and ably discussed, especial attention being given to those which are of industrial importance, *e.g.* common Alcohol, Acetic Acid, and the Higher Acids of the Fatty series, which enter into the composition of soap. Several industrial processes are described in considerable detail, and amply illustrated by figures, *e.g.* the separation of the Paraffin-oils by fractional distillation, the manufacture and rectification of Alcohol, the testing of the strength of Spirits and of Wine and Beer, the preparation of Vinegar, and the manufacture of Soap. And here perhaps it may not be out of place to point out the great practical importance of Organic Chemistry, which, strange to say, has been called in question by some writers in the periodical press, who have spoken of it as consisting, in great part, of elaborate trifling about compounds of little practical importance, but rejoicing in names of fearful length, and formulæ of excruciating complexity—and in fact treating this branch of chemical science as altogether of second-rate importance in comparison with Mineral Chemistry. Now the importance of this last-mentioned branch of chemistry, which includes the description of the Metals and their Compounds, is of course beyond all question; but it is perhaps not too much to say that at least an equal value in a practical point of view may be ascribed to that department of the science which is concerned with the materials of our food and clothing, and with the constitution of the compounds which make up the bodies of plants and animals. To remove any doubt that may yet exist as to the practical importance of Organic Chemistry, we can imagine nothing more effectual than a perusal of the volume under consideration, the appearance of which will doubtless be hailed with pleasure by all who are interested in the subjects of which it treats.

H. WATTS

OUR BOOK SHELF

Acoustics, Light, and Heat. By Thomas W. Piper. (London: George Philip and Son, 1881.)

THIS little work is not without its merits, the descriptions of the simpler phenomena and laws of these branches of physics being for the most part clear, accurate, and couched in easy language. The arrangement adopted in the chapters of the book is a departure, and we think not a very wise one, from the usual order of subjects in elementary text-books of physics. After a preliminary chapter on the atmosphere, its elasticity and its weight, the author plunges into vibratory motion, and under this head treats of acoustics. Chapter III. is on rectilinear motion, under which heading we have the following subjects:—The reflection of sound, the linear propagation of light, reflection of light and its applications, convection, radiation, and conduction of heat, laws of curved mirrors, laws of refraction, lenses, magic lantern, refraction of sound, spherical aberration of lenses, and, lastly, properties of matter. We have quoted these in the order in which they occur, and cannot help thinking that, however clearly the individual subjects are treated of, this heterogeneous lumping together of them must hamper the comprehension of beginners. Chapter IV. deals with the conservation of matter, including expansion by heat; Chapter V. is on thermometers. Chapter VI., on the conservation of energy, is another example of the author's peculiar method. It begins with the correlation of forces, deals with the prismatic spectrum, diathermancy, acoustic resonance, the laws of vibrations of strings, and specific heat. The book concludes with a chapter on sensation, optical and acoustical. Except for these aberrations of arrangement, and for one or two slips, the book would be a satisfactory one for beginners in natural philosophy.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.*

[*The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to ensure the appearance even of communications containing interesting and novel facts.*]

The Parasitic Habits of Molothrus

IN the "Origin of Species" I adopted the view maintained by some writers, that the cuckoo lays her eggs in other birds' nests, owing to her habit of laying them at intervals of two or three days; for it could hardly fail to be disadvantageous to her, more especially as she has to migrate at a very early period, to have young birds of different ages and eggs all together in the same nest. Nevertheless this occurs with the non-parasitic North American cuckoo. If it had not been for this latter case, it might have been argued that the habit of the common cuckoo to lay her eggs at much longer intervals of time than do most other birds, was an adaptation to give her time to search for foster-parents. The Rhea or South American ostrich is believed likewise to lay her eggs at intervals of two or three days, and several hens deposit their eggs in the same nest on which the male sits; so that one hen may almost be said to be parasitic on another hen. These facts formerly made me very curious to learn how the several species of Molothrus, which are parasitic on other birds in very varying degrees, laid their eggs; and I have just received a letter from Mr. W. Nation, dated Lima, September 22, 1881, giving me information on this head. He says that he has there kept in confinement for a long time *Molothrus purpurascens*, and has likewise observed its habits in a state of nature. It is a resident species of Western Peru, and lays its eggs exclusively in the nests of a sparrow (*Zonotrichia*), starling (*Sturnella bellicosa*), and a pipit (*Ænthus chii*). He then proceeds: "The eggs of the sparrow are very much like those of the Molothrus in size and colour. The eggs of the starling are larger and somewhat different in colour; while the eggs of the pipit are very different both in size and colour. Generally one egg of the Molothrus is found in a nest, but I have found as many as six. The young Molothrus does not always eject its foster-brothers; for I have seen a young one nearly fully feathered in a nest with two young starlings. I have also found two young birds of the Molothrus nearly fully feathered in the nest of a starling; but in this instance the young starlings had been ejected from the nest." He then states that he had long kept in confinement a male and female of this species of Molothrus, which are now six years old. The hen began to lay at the age of two years, and has laid each time six eggs, which is the number laid by Icterus, a near ally of Molothrus. The dates on which the eggs were laid this year are as follows:—February 1, 6, 11, 16, 21, and 26; so that there was an interval of exactly four clear days between the laying of each egg. Later in the season she laid six additional eggs, but at much longer intervals and irregularly, viz. on March 8, April 6 and 13, May 1, 16, and 21. These interesting facts, observed by Mr. Nation in relation to a bird so widely distinct from the cuckoo as is the Molothrus, strongly support the conclusion that there is some close connection between parasitism and the laying of eggs at considerable intervals of time. Mr. Nation adds that in the genus Molothrus, out of every three young birds he has invariably found two to be males; whereas with Sturnella, which lays only three eggs, two of the young birds are, without any exception, females.

CHARLES DARWIN

Down, Beckenham, Kent, November 7

The Velocity of Light

IN reply to Mr. Macaulay (NATURE, vol. xxiv. p. 556) I will endeavour to explain more clearly the statements, made in my former communication on this subject (NATURE, vol. xxiv. p. 382). On one important point the explanation will include a correction.

With reference to the group-velocity U, we know from Fourier's theorem that any disturbance travelling in one dimension, can be regarded as resulting from the superposition of infinite trains of waves of the harmonic type, and of various amplitudes and wave-lengths. And we know that any one of these trains, of wave-length λ, is propagated unchanged with a velocity V, which we regard as a known function of λ, dependent upon the nature of the medium.

Unless we can deal with phases, a simple train of waves presents no mark by which its parts can be identified. The introduction of such a mark necessarily involves a departure from the original simplicity of a single train, and we have to consider how in accordance with Fourier's theorem the new state of things is to be represented. The only case in which we can expect a simple result is when the mark is of such a character that it leaves a considerable number of consecutive waves still sensibly of the given harmonic type, though the wave-length and amplitude may vary within moderate limits at points whose distance amounts to a very large multiple of λ. We will therefore suppose that the complete expression by Fourier's series involves only wave-lengths which differ but little from one another, and accordingly write it—

$$a_1 \cos\{(n + \delta n_1)t - (\kappa + \delta\kappa_1)x + e_1\}$$
$$+ a_2 \cos\{(n + \delta n_2)t - (\kappa + \delta\kappa_2)x + e_2\} + \ldots\ldots,$$

or in the equivalent form—

$$\cos(nt - \kappa x)\,\Sigma a_1 \cos(\delta n_1 t - \delta\kappa_1 x + e_1)$$
$$- \sin(nt - \kappa n)\,\Sigma a_1 \sin(\delta n_1 t - \delta\kappa_1 x + e_1),$$

where $\kappa = 2\pi/\lambda$, and $n = \kappa V$. From this we see that, as in accordance with the suppositions already made,

$$\frac{\delta n_1}{\delta\kappa_1} = \frac{\delta n_2}{\delta\kappa_2} = \ldots = \frac{dn}{d\kappa},$$

the deviations from the simple harmonic type travel with velocity $dn/d\kappa$, and not with velocity n/κ, that is with velocity $d(\kappa V)/d\kappa$, and not with velocity V.

I now pass on to the theory of Foucault's experiment. If D be the distance between the fixed and moving mirrors, ω the angular velocity of the latter, then the angle through which the mirror turns in the time occupied by the wave in making the double journey is $2D\omega/V$, and the angular deflection θ, which is the immediate subject of observation, is according to the usual view—

$$\theta = \frac{4D\omega}{V}.$$

Now it is here assumed that the deflection is due merely to the change of position of the mirror between the two reflections, and that the wave returns to the mirror with its front parallel to the position occupied immediately after the first reflection, as would be the case if the mirror were at rest. But if V be a function of λ, this assumption is not true. Besides the deflection above considered, there is another depending upon the fact that the wave front rotates in the air between the two reflections. The rotation is a consequence of the inclination to one another of successive wave fronts, which involves a variation of wave-length and therefore of velocity at points situated on the same wave-front in a line perpendicular to the axis of rotation. Denoting distances measured along this line by x, we have for the angular velocity of the wave's rotation—

$$\omega' = \frac{dV}{dx} = \frac{dV}{d\lambda}\frac{d\lambda}{dx},$$

in which $d\lambda/dx$, representing the angle between successive wave-fronts of similar phase, is equal to $2\omega\lambda/V$. Accordingly—

$$\omega' = 2\omega\frac{d\log V}{d\log\lambda},$$

and the actually observed rotation is—

$$\theta = \frac{4D\omega}{V}\left(1 - \frac{d\log V}{d\log\lambda}\right).$$

The result of a calculation which leaves the aërial rotation out of account is therefore not V, but—

$$\frac{V}{1 - \dfrac{d\log V}{d\log\lambda}}$$

Now

$$U = \frac{d(\kappa V)}{d\kappa} = V\left(1 + \frac{d\log V}{d\log\kappa}\right) = V\left(1 - \frac{d\log V}{d\log\lambda}\right);$$

so that the result of the experiment is V^2/U, and not as previously stated the group velocity U itself. The error arose from a mistake as to the direction of the effect of ω'.

The force of the arguments which I founded upon these considerations is increased rather than diminished by the correction, and with Mr. Michelson's evidence on the same side of the question almost excludes any appreciable variation of V. It should be noticed that by the combination of the two methods of the toothed wheel and of the revolving mirror we have the means of determining both V and U, and the results of Cornu and Michelson appear to prove, independently of astronomical observation, that there is no sensible difference between them.

Indeed by a slightly varied arrangement it would seem possible to determine V directly from Foucault's experiment. If a convex lens were so interposed at the distant station that the fixed mirror occupied its focus, the sides of short and long wave-length would be interchanged, and thus the rotation acquired during the outward journey would be neutralised during the return.

RAYLEIGH

The Struggle of Parts in the Organism

I AM very glad to learn that Mr. Romanes fully accepts as "well-known and unquestionable" the definition of the term *law of nature* which I propounded as expressing its true scientific sense; but I would suggest to him, as to other writers who are accustomed to speak of such laws as "governing" phenomena,[1] whether the use of such "metaphorical" language is not objectionable, as tending to keep up in the *un*scientific mind the notion of the "coercive" and "self-sufficient" agency of natural laws. I am glad also to be able to express my entire accordance with Mr. Romanes in regard to the inferiority of the teleological argument based on *special instances* of adaptation of means to ends, to that which is based on the *general order* which we designate by the term law. For I maintained this view even in that remote pre-Darwinian age in which my scientific life commenced, urging to the best of my young ability, forty-three years ago,[2] that the principles admirably laid down by Whewell in regard to physical inquiry, viz. that final causes should be excluded, because "we are not to assume that we know the objects of the Creator's design, and put the assumed purpose in the place of a physical cause," and that "the notion of design and end is transferred by the researches of science from the

[1] I continually meet with this phrase in the pages of NATURE.

[2] See *British and Foreign Medical Review* for April, 1838: "Physiology an Inductive Science."