THURSDAY, OCTOBER 30, 1879

STERRY HUNT'S CHEMICAL AND GEOLOGICAL ESSAYS

Chemical and Geological Essays. By Thomas Sterry Hunt, LL.D., F.R.S., &c. Second Edition, revised, with Additions, pp. 489. (London: Trübner and Co., 1879.)

THIS book contains twenty essays, and a preface, itself an essay, some of which were written as early as 1853, and the others have appeared from time to time, either as original contributions, reviews, or lectures. These literary and scientific efforts are but a small part of Dr. Sterry Hunt's contributions to chemical and dynamical geology, but it would appear, from the preface to the first edition, that a selection was made upon a definite idea. The selected essays, as a whole, cover, he considers, nearly all the more important points in chemical geology; and the introduction of one relating to the hypothesis of a cooling globe and of "certain views" of geological dynamics, he considers make together a complete scheme of chemical and physical geology. He was disposed to re-write some of the essays, but this was not done, because they seem to the author to have a certain historic value and serve to fix the dates of the origin and development of views, some of which, after meeting for a time with neglect, or with active opposition, are now beginning to find favour in the eyes of the scientific world. Dr. Sterry Hunt states that his views, for which his fellow-workers were not prepared, were subsequently propounded by them as new discoveries or original conclusions. Five of the papers, moreover, contain, according to the author—writing in 1874—the germs of a philosophy of chemistry and mineralogy which he hopes one day to develop himself or to see developed by others.

There is no doubt that, although Dr. Sterry Hunt may be satisfied that his views are correct on all the very numerous subjects he has entertained, there is not a single chapter, one might say a single page in many, which will not meet with very decided opposition on the part of scientific men who are not likely, in after years, to let their hypothetical conversion precede their assumption of originality.

It is difficult in reading this book, full of good facts, but crammed with hypotheses and arguments about priority of thought, to believe that the author is a most genial man, and who is imbued with the true spirit of science. Very much of the type of the late David Forbes, he really is the last man whom one would believe would be so dreadfully polemical. Yet he must know that the book can only be appreciated by advanced geologists and chemists who really do care that the discoverer of a *fact* or of a *method* should have a proper priority, but who do not care about who first put forward certain *views* on subjects incapable of proof or indulged in scientific *guesses* before the fact. There is no doubt that with regard to a science like that of geology, men working in different countries at the same subject, arrive simultaneously at the truth or what seems to be true in relation to facts which are common property. A register of opinion, whether expressed at lectures, debates, addresses, or published in journals, is clearly impossible. Moreover, there is a great amount of unwritten geology which is common knowledge, but no one thinks it worth while to write it and claim a priority. Hence any one taking up a variety of subjects must suffer from not having his ideas recognised at once and may really be unfairly placed in the background. But as there is usually no intention of an evil character, it is unwise to be so very touchy upon priority in hypothesis. Very characteristic of certain zealous minds, is this everlasting harping on who made the discovery of a fleeting hypothesis first.

On looking over these essays we are struck that whilst a controversy with Dana is recorded, the celebrated reply of David Forbes to some of the author's views is not given. And some of the contributions seem to represent former views of the author, and not those which he has since developed. Mallet will feel uncomfortable when he reads how he has been forestalled in his kinetic theory, but it is satisfactory to have the cap put on the right head. Dr. Sterry Hunt has settled volcanicity, and may be thus quoted: "With the contributions of Vose and Mallet, the theory of volcanic action advocated by Keferstein, Herschel, and myself, would seem to be well-nigh complete." This self-commendation will, however, not establish the nonsense of Keferstein, whom the author terms irrational, or the mere passing expression, without confirmatory facts, of Vose, and it will not enable him to stand on the same footing as the philosophic and modest Mallet.

Should any geologist make an original suggestion, do not advise him to refrain from publication; or if it is to be given to the world, let it be done at once. Otherwise Dr. Sterry Hunt may suffer, as he did in the odd matter of limestones, dolomites, and gypsums, and the illustrious but reticent Cordier. On October 28, 1844, a memoir was deposited with the Academy by this geologist. Being in a sealed packet, writes Dr. Sterry Hunt, its contents remained unknown until after his death, when at the request of his widow the seal was broken. No money was found and not a codicil, but on February 17, 1862, a remarkable theory transcending everything geological and fully explanatory of the formations of those limestones, came to light. It fell flat, for Dr. Sterry Hunt had maintained similar views, or rather more correct views, for four years.

Prof. Ramsay is so hardened a debater that he will not be utterly cast down, it is to be hoped, by having one of his hypotheses snatched from him and placed on the prior brow of our author. It was not for some years that certain *views* of the author on the formation of dolomites "found recognition." "When Prof. A. C. Ramsay, by the investigation of the magnesian limestone of the Permian in England, was led to reject as untenable the notion held by Sorby (and by others) that this was once an ordinary limestone of organic origin subsequently impregnated with magnesian carbonate under conditions not explained; and to conclude that the carbonates of lime and magnesia of which it is composed had been deposited simultaneously by the concentration of solutions due to evaporation in an inland salt lake." To this view as he informs us, he (Ramsay) was led by physical considerations and "by the depauperated condition of the organic remains contained in these strata, *without being at the time aware that I had twelve years previously announced the same conclusions for all magnesian limestones, and established them on chemical grounds*." The italics are ours, for Prof. Ramsay's especial benefit. The author concludes his last essay on the theory of types in chemistry, with some good advice to a thoughtless-Sterry-Hunt-neglecting posterity :—" In conclusion I have only to ask that future historians will do justice to the memory of Auguste Laurant, and will, moreover, ascribe to whom is due the credit of having given to the science, a theory which has exercised such an important influence in modern chemical speculation and research; remembering that my own publications on the subject, which cover the whole ground, were some years earlier than those of Williamson, Gerhardt, Würtz, or Holbe." It is a pity that much good scientific work should be encumbered by these vanities, and really much that is objectionable can be compensated by the study of such essays as those on the chemistry of natural waters, which is admirable and suggestive.

THE PHILOSOPHY OF MUSIC

The Philosophy of Music. Royal Institution Lectures. By W. Pole, F.R.S., F.R.S.E., Mus. Doc. Oxon. (London : Trübner and Co., 1879.)

IT has long been felt by intelligent persons anxious to possess some acquaintance with the scientific side of music, that the technical works to which they have recourse for the desired knowledge are unsatisfactory from a logical point of view. We are acquainted with no work on technical music which offers any reasonably intelligent explanation of the basis on which its material is founded; and a school has arisen, no doubt partly as a reaction from the crude speculations and unsupported dogmatism of many standard works, which refuses to acknowledge anything beyond the mere acquirement of technical facility in composition as a desirable object in the study of the so-called science of music.

The work of Dr. Pole appears to be intended as a protest against this limitation. It is an endeavour to make plain so much of æsthetic and physical acoustics, and the *rationale* of technical music, as may enable the musician to give some sort of intelligent reason for the faith that is in him.

Dr. Pole's well-known musical attainments are a guarantee for the soundness of the work so far as musical technicalities are concerned. As to general questions of evolution, the nature and objects of musical grammar, the origin and nature of scales, and of the technical rules of music, we think that this book leads the way among English works, in a logical, or perhaps we had rather say, in a common sense treatment of the subject.

It is useless within the limits of this article to attempt to convey any idea of the arguments employed. For the most part the opinions of Helmholtz have been adopted. Whatever may be the ultimate opinion as to the absolute accuracy of these views, there can be no doubt that their admission changes the fundamental study of music from an unmeaning dogmatism into a science.

The first part of the work gives a sketch of the material of music, and forms a treatise on elementary acoustics. The second part deals with the evolution of melody, the history of the scale, melodic and harmonic relations, rhythm and form. The third part is entitled "The Structure of Music." Its most important items are the history of harmony, and the discussion of its rules, combinations, and progressions. It concludes with a slight notice of counterpoint. The characteristic of the book seems to be that a good idea may be obtained from it of a sound body of musical doctrine, comprising foundation, history, and technique.

We select two or three points for notice, as to all of which we are not perhaps quite in accord with Dr. Pole.

There is something yet to be said as to the difference in the way in which the highly gifted musician and the ordinary listener hear music. The observations on the decay of counterpoint (p. 288) seem to want some notice of this. It is more or less a waste of energy to write music in many parts, all of which are made melodious at some sacrifice of the harmonic effect, when not more than perhaps one in a hundred listeners is capable of hearing more than one melody at a time. We think that it is not the power of writing counterpoint that has died out so much as the will to write it. There can be no doubt that the unpopularity of counterpoint is mainly due to the fact that the ordinary listener is unable to hear in it what the highly gifted musician hears. The many simultaneous melodies are quite lost on the ordinary listener. It is only in the case of the greatest composers, whose principal melodies and harmonies do not suffer by their attention to the counterpoint, that works of this class attain any popularity. Until the acquirement of the power of hearing many simultaneous melodies is placed within the reach of the ordinary listener by a suitable and widespread education specially directed to this purpose, it is useless to look for a popular interest in counterpoint, which shall encourage the composer to produce it. There is a question how far it is possible for a person not naturally gifted with the polyphonic ear to acquire it in perfection. But there can be no doubt that systems of education are possible which will do much towards advance in this direction; and that the direct cultivation of polyphonic hearing and reading is the shortest cut towards the formation of the true musician.

There is an incompleteness in Dr. Pole's statement of Helmholtz's explanation of consonance and dissonance, which is important, as it affects the logical foundation of this part of the work, which however forms but a subsidiary portion of Dr. Pole's book. The point in question has been discussed at large some time ago by Prof. Mayer, Mr. Sedley Taylor, and others. It will be sufficiently explained by quoting the summary of the principles which Dr. Pole employs in the discussion of the examples of chords, and also a passage from Helmholtz which contains the considerations omitted.

(Dr. Pole's book, p. 210.) "Now having given these two data, velocity of beating, and strength of beating notes, we may examine some of the binary harmonic combinations of sounds, and see in what manner and to what extent the partial tones, of which the sounds are made up, give rise to the beating or harshness above described."

The following passage will show that another set of data is required, namely, the law according to which the production of beats in the ear between pure tones depends on the interval:—

(Ellis's "Helmholtz," p. 260.) "On the other hand we have seen that distinctness of beating and the roughness of the combined sounds do not depend solely on the number of beats. For if we could disregard their magnitudes all the following intervals, which by calculation should have 33 beats, would be equally rough:—

"The semitone ... ... $b'\ c''$
,, whole tones ... ... $c'\ d'$ and $d'\ e'$
,, minor third ... ... $e\ g$
,, major third ... ... $c\ e$
,, fourth ... ... G c
,, fifth... ... ... C G
(to which we may add the octave ... ... C_1 C).

"and yet we find that the deeper intervals are more and more free from roughness."

Helmholtz then proceeds to give an approximate determination of this important law, for which we must refer to his work. Our own impression is that this law is almost solely concerned in the variation of the roughness of different combinations. We ourselves hear the roughness of beats up to very high numbers, and consider that up to high numbers beats of sensible intensity do not fail to be heard by reason of their number only. If this is the case the rapidity of beats must be of less importance in the theory of consonance than the law of dependance on intervals exhibited in the above quotation from Helmholtz.

To show the practical importance of this:—

(Pole, p. 213.) "Here we find the two fundamental notes themselves ($c' - e'$) beating at the rate of 64 per second. . . . This is, therefore, a less perfect combination than the fifth; but still the beats are quick, and the effect is not disagreeable."

This seems to us incorrect. If the 64 fundamental beats per second were present with any intensity to speak of, the combination would certainly be most dissonant. It is because the ear receives the two notes on different parts of the sensorium, and so gets them out of each other's way, that the beats do not exist in sensible intensity, and do not produce dissonance.

In the appendix on Beats, and an essay there referred to, Dr. Pole has developed doctrines which arise to some extent from the point of view above indicated. The statement made is substantially that the beats described by Robert Smith ("Harmonics," 1749), have a real existence, besides the various types of beats described by Helmholtz.

Smith's cycles are best seen if the sum of two harmonic curves be described by Donkins's harmonograph, or some such machine. Smith's doctrine consists of the statement that the cycles which appear in the resulting curves are the cause of the beats. (Of course Smith did not use pendulum-vibrations, but the use of these adapts the doctrine to our modern knowledge.)

Now in order that these cycles may be seen, it is necessary that one and the same scribing point should describe the sum of the two motions simultaneously. If the motion be analysed and its two components be described separately on the paper, the cycles fail to appear.

This is what must happen in the ear if the doctrines of Helmholtz are even approximately true. The two sounds (if beyond the minor third apart) fall more or less completely on different parts of the sensorium, and the conditions requisite in the first instance for the formation of Smith's cycles are not fulfilled. Whether, if the cycles existed, the beats could arise out of them in the way in which we hear them, is quite a different question, on which we will not now enter.

The great importance of this question has induced us to prolong our remarks on it. On these points every student should consult Helmholtz's work. But on the more purely musical questions Dr. Pole's book has its own value.

OUR BOOK SHELF

A Treatise on Chemistry. By H. E. Roscoe, F.R.S., and C. Schorlemmer, F.R.S., Professors of Chemistry in Owens College, Manchester. Volume II. Metals. Part II. (London: Macmillan and Co., 1879.)

THIS portion of Professors Roscoe and Schorlemmer's work treats of the metals of the iron, chromium, tin, antimony, and gold groups, also of spectrum analysis, the natural arrangement of the elementary bodies, and the condensation of the gases formerly called permanent. The treatment of these subjects is characterised by the same accuracy of description and clearness of explanation and arrangement that were so conspicuously displayed in the former parts, and the illustrations of metallurgical operations, &c., are well chosen and admirably executed, such, indeed, as are not to be found in any other English manual of chemistry. Amongst them may be especially noticed the figures of the plant for Weldon's method of regenerating manganese dioxide from chlorine residues, of the various forms of blast-furnace, of the Bessemer and Siemens-Martin processes for making steel, and of hydraulic gold-mining as practised in California. The best methods of detecting and estimating the several metals are carefully described, and interesting details are given relating to their history, some of which will, we think, be new to many readers.

Spectrum analysis, in which Prof. Roscoe is known to be a high authority, is well treated and illustrated, and attention is drawn to recent speculations, founded on spectroscopic observation, respecting the possible resolution of the bodies now regarded as elementary, into still simpler forms of matter. In the chapter on the Natural Arrangement of the Elements, a clear view is given of the remarkable relations between the properties of the elements and their atomic weights, first pointed out by Mr. Newlands, and further developed by Lothar-Meyer, and Mendelejeff; and the volume concludes with an account of the condensation of the gases formerly regarded as permanent, in which the ingenious forms of apparatus employed for the purpose by MM. Cailletet and Pictet are fully described and illustrated.

Altogether the two volumes of the work now published form a treatise on Inorganic Chemistry of which English science may well be proud; and the student who masters their contents will not fail to acquire a sound elementary knowledge of the subject. H. WATTS

Elementary Mechanics, including Hydrostatics and Pneumatics. By O. J. Lodge, D.Sc. Chambers's Elementary Science Manuals. (Edinburgh, 1879.)

THIS is one of the comparatively sound text-books which, since the publication of Thomson and Tait's work, have been every year more effectually thrusting aside the cumbrously artificial and often erroneous introductions to Physical Science which reigned almost unchallenged till about sixteen years ago. Dr. Lodge knows his subject well, and has evidently bestowed very careful thought upon it. Still we cannot unreservedly commend his book; and this for several reasons. First, he evidently proceeds under the idea that the subject can be made easy to a beginner; that, in fact, there are no real difficulties which must be fairly faced by every student. We are surprised to find that this opinion can be held by any sound and successful teacher. Our own experience has always been dead against it. Dr. Lodge says of the elementary works of Thomson and Tait, Clerk-Maxwell, and Clifford, that they are "far too difficult for beginners." We do not think that his process of dilution makes the matter a whit less difficult. It has rather a tendency to conceal from the reader the place where the real difficulty lies, and a necessary difficulty *avoided* is certainly not *overcome*. Second, the avoidance of difficulties is managed by loose and sometimes even metaphysical language (see, for instance, pp. 83-5); evidently embodying some of the speculations in which the author has indulged while excogitating his work.

As an instance of loose writing take this (p. 16)

"5. The effects of force on matter are:
A. Change of motion, which is called *acceleration*.
B. Change of size or shape, which is called *strain* or deformation.

If only one force acts on a body, it must produce the effect A. If two or more forces act in different directions on a body, they must produce B, and they may produce A also." Now, at first sight, this looks well enough, and certainly Dr. Lodge knows the facts thoroughly. But how is *change of motion* called *acceleration?* Acceleration is correctly defined (p. 19) as *Rate* of change of *velocity*. But (p. 18) velocity is defined as "the rate of motion of a body." Put these extracts along with A above, and we find "change of that whose rate is called velocity is rate of change of velocity;" a very remarkable proposition, indeed one of high metaphysical interest. Again, if only one force act on a body, it *must* produce B unless the body be perfectly rigid. And two or more forces do *not* necessarily produce B, even on the most plastic body. Take the case of two different sets of parallel forces, for instance, each proportional to the mass of the element on which it acts.

In conclusion we may say that for the facts of elementary mechanics, for excellent examples of application of the formulæ, and such like matters, the student may use this work with profit:—but he ought to be warned that where the text appears most simple it is generally loose, often metaphysical, and here and there unintelligible.

Le conchiglie Pompeiane. Descritte dal Dott. Nicola Tiberi. 4to, 12 pp. (Napoli, 1879.)

THIS remarkable and well written memoir was published before the recent celebration at Pompeii of the eighteenth centenary of its destruction by a volcanic eruption of Vesuvius. It is the work of an excellent naturalist, who lives at Resina, close to the site of the ruined city, and who is especially conversant with the shells of the Mediterranean. The point of view to which he directs our attention is very different from that which has been taken by the geologist, antiquary, artist, or architect. He treats of the shells found in the ruins, and which had served for food, or been used by the Pompeians for ornament and other purposes. Indeed we know from Athenæus and other ancient authors that mollusca were then relished quite as much as they are at present by the inhabitants of Italy. I have been unable to discover in the loose and incorrect twaddle of the younger Pliny, who lost his life in the eruption, any mention of shells having been collected by his countrymen for the study of natural history. It is a pursuit or amusement of comparatively modern times. Dr. Tiberi gives a list of all the shells which he has noticed as Pompeian, belonging to no less than 44 species, with particulars of their relative abundance at Pompeii, as well as of their distribution and economy. Some were of eatable kinds, as the common oyster and mussel, *Pecten jacobæus*, *Venus chione*, *Tapes decussatus*, and several species of *Helix*. Others adorned fountains, as *Haliotis tuberculata*, *Murex trunculus*, and *M. brandaris*. The oriental pearl-shell (*Meleagrina margaritifera*) was represented only by a single valve. But the ladies of Pompeii seem to have attached considerable value to the *Cypræa* or Cowry, as amulets or charms to prevent sterility; and among these shells were some of species from the Red Sea and Persian Gulf. A single specimen of another exotic shell (*Conus textilis*) must have been kept for its great beauty as an object of curiosity. All the shells used in the ornamentation of fountains, five in the city and one in the suburbs, are of species which still are common in the Gulf of Naples; these shells are separately distinguished and named.

The memoir forms a short but interesting chapter of Roman history, and it tells us more than is generally known about the habits of the former masters of the world. J. GWYN JEFFREYS

Banka und Biliton. Von Dr. E. Reyer. (Vienna, 1879).

IN this pamphlet, originally published as an article in the *Oesterreichischen Zeitschrift für Berg- und Hüttenwesen*, the author has brought together a vast amount of useful information on these two important tin-yielding localities. At the present time, when the trade in this important but sparingly-distributed metal has been almost entirely diverted from its ancient centres in Cornwall and Saxony by the development of the sources of supply in the East Indies and Australia, the valuable details contained in this pamphlet cannot fail to be read with much interest. By far the largest and most reliable part of the information on these districts is inaccessible to most readers, from the fact of its being written in the Dutch language, and Dr. Reyer has done good service in bringing together so much material in a compendious and available form. The geological structure of the districts, the distribution of the ore in them, the methods of working, and the mineral statistics of the two areas, are very fully described, and the monograph concludes with an interesting sketch of the life of the Chinese immigrants who are engaged in working these tin ores in the Malay Archipelago.

J. W. J.

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.*]

Greenwich Meteorological Observations

MR. BUCHAN (NATURE, vol. xx. p. 602) now admits that fundamental mean temperatures are to be found in Table 77. But his original unqualified remark (p. 526) was that mean temperatures for Greenwich "remain still to be calculated"; he even endeavoured to infer the mean annual temperature from the observations of the earth-thermometers, as though Table 77 (containing a value of this element with which no hitherto determined value for Greenwich can compete) had no existence. All this was likely to convey to an uninformed reader a very erroneous impression.

Table 52 contains simply a collection of the mean monthly results given in the twelve tables (38 to 49) referring to diurnal inequality, and as these numbers appeared to sufficiently well represent the varying temperatures of individual months, no account was taken of omitted days. But we can without difficulty determine their influence, usually small, in the months affected, and, in consequence of the now expressed want, shall probably take an opportunity of doing so. The question was of much greater importance as regards the fundamental values of Table 77, in forming which, as before mentioned, and as is stated in the introduction to the volume, the influence of omitted days was duly taken into account, values for such days being adopted from the eye-observations (usually six daily) corrected for diurnal inequality by means of corrections derived from the discussion of the twenty years' photographs. Thus, among the twenty separate daily values on which each mean daily value in Table 77 depends, one or two may be derived from eye-observations in the way described.

The diurnal variation of temperature in the apartment in which the photographic barometer is placed is, on the average, less than one degree. WILLIAM ELLIS

Royal Observatory, Greenwich, October 27

Sun-Spots in Earnest

WITH reference to the fine group of sun-spots to which Prof. Piazzi Smyth draws attention in NATURE, vol. xx. p. 602, it may be interesting to mention that the incipient stage of the group in question is shown on two photographs of the sun taken at the Royal Observatory, Greenwich, on October 16 (two days before the date of Prof. Piazzi Smyth's observation). At that time the group consisted of three "veiled" spots and several very small specks hardly to be distinguished from the ordinary pores, together with small faculæ. No photographs were obtained on the next day, and on October 18 enormous changes had taken place, the "veiled" spots having developed into fine sun-spots, with nucleus and penumbra. Four photographs taken on this day show that changes were still taking place, and these continued throughout the remainder of the period of visibility of the group, viz., till October 21, when it passed off at the west limb. No trace of the group is to be found on two photographs taken on October 15, so that it would appear to have formed between October 15 and 16, and must have been quite in its infancy when first photographed on October 16, being then very nearly on the central meridian.

Several small spots have appeared on the sun lately, but they have been for the most part very short-lived. Thus a group of spots with faculæ, first seen on the east side of the sun on October 15, had completely disappeared on October 16. Another group consisting of six or seven small spots with faculæ, which appeared at the east limb on October 7, had completely closed up in the interval between October 10 and 15. On the whole the Greenwich photographs seem to support Prof. Piazzi Smyth's conclusion that the period of quiescence is now over, and that the solar activity is decidedly on the increase. W. H. M. CHRISTIE

Royal Observatory, Greenwich, October 25

THE Kew solar observations now are, unfortunately, limited to a daily inspection of the sun through a 3-inch telescope, and the drawing of a rough sketch of the spots on its surface, should any be visible, the object the Committee have in view being merely a continuation of the enumeration of the groups as they make their appearance, in the same manner as did Hofrath Schwabe.

I have referred to the sketches drawn on the 15th, 16th, 17th, and 18th instants, in order to see what records they afford of the outbreak of the group of spots mentioned by Prof. Piazzi Smyth in NATURE, vol. xx. p. 602, and find we noted on the 15th two small spots in the sun's northern hemisphere. These were not seen on the 16th, the disk being entered in the register as having "no spots," but at 10.30 A.M. on the 17th a group of small spots appeared to the south of the equator, just in the place occupied on the next day by the group of gigantic spots to which attention has been directed, allowance of course being made for the sun's rotation.

These observations show that the spots did not suddenly burst forth in their full grandeur, but that they broke through the sun's surface gradually, that is to say, the explosion, if such it was, extended over more than twenty-four hours.

In the examination of the Kew solar photograms from 1863 to 1872 now in progress here under the direction of Mr. De la Rue, we have found several instances of similar extensive changes in spots from day to day, not only in the eruption of large spots, but also in their closing up in an equally short space of time.

To give more recent instances, I find that a considerable group of spots was observed on June 28, of which we had no record on the 25th; and again, on July 11, some large spots were noted, whilst on the preceding day, July 10, "no spots" was entered in the register.

The magnetograph curves show a slight disturbance of the magnetic elements on the 16th and 17th, but during the 18th the needle simply recorded its ordinary daily range.

I trust that better-equipped observers will be able to give you more exact accounts of this interesting phenomenon. The sunshine recorder here indicated continuous sunshine on the 16th, occasional gleams on the 17th, and seven hours on the 18th, so the climate cannot be blamed for any shortcomings on the part of southern observers on this occasion. G. M. WHIPPLE

Kew Observatory, October 25

THE conclusion as to the increasing activity of the solar surface, drawn by the Astronomer-Royal of Scotland from his observations of a large solar spot on the 18th instant, is strongly confirmed by the present state of the south-east quarters of the sun's disk. Few prominences are now visible in the other portions of the limb, but on the 26th at 23° 10′ E. of the south point (direct image), the bright line C of the chromosphere extended to the height of 3′ 43″ from the limb, and this morning, the 28th, the greatest height was 1′ 17″ at 18° 46′ E. of S. On the 28th the remarkable prominences extended along the limb from—

18° 8′ E. of S. to 38° E. of S.,

and this morning they were traced from—

10° 51′ E. of S. to 20° 21′.

The ordinary level of the chromosphere does not extend above 5″ from the limb, but to-day it was rather over 6″.

Eight prisms of 60° were used in a Browning automatic spectroscope adapted to an 8-inch achromatic. S. J. PERRY

Stonyhurst Observatory, October 28

Wallace's "Australasia"

ALLOW me to thank the writer of the review in NATURE, vol. xx. p. 597, for some valuable criticisms of my book. It is quite refreshing after the common-place praises of most reviews to have one's errors pointed out and omissions noticed, and I hope to make use of such corrections in a forthcoming new edition. At the same time there are a few points on which I wish to say a word. In the first place the book is not a scientific work, but one of a series intended, as expressly stated, "for general reading." This is, of course, no excuse for errors, but it is a sufficient reason for giving *general* rather than detailed descriptions of weapons, canoes, &c., and for occasionally stating roughly the *size* of an article even when it varies greatly, in order to give definite ideas to readers who may be complete strangers to the whole subject.

I quite agree with my reviewer, that too much is included to be properly treated in one volume, but that was a matter dependent on the arrangement of the series, over which I had no control; and as I had in the earlier portion of the work overrun the space allotted me, I was obliged to restrict my notices of many parts of Polynesia, which is no doubt the most imperfect portion of the volume. It is here that the original work is most utilised, and it will be found that most of the passages criticised (including that in which I am charged with "becoming quite poetical") are Hellwald's. Of course, I should have corrected all his small inaccuracies, but it was almost impossible to do so without rewriting his work altogether. No doubt a very interesting volume could be written on Polynesia alone by the aid of the German authorities referred to by the reviewer; but when I state that the time allowed me for the composition of the entire work was six months, and that I actually completed it in eight, it will be seen that I was compelled to limit myself in the study of authorities as well as in the space I could devote to particular islands.

I think my reviewer forgets the character of the book as essentially geographical, when he objects to my treating New Zealand apart from Polynesia; hence I cannot admit the soundness of his criticism on the comparison of the characters of the Fijians and Polynesians, a comparison which, if I remember rightly, is that of an author who knew them both thoroughly—the Rev. G. Turner. I must also demur to the implication that land can never have extended where there is now a sea 2,000 fathoms deep. I suggest (p. 564) an extension of New Zealand as far as the Kermadec Islands as having possibly occurred "at some remote epoch," and I certainly fail to see its impossibility; yet this is what is suggested by my reviewer's remark, that unfortunately there is a depth of 2,000 fathoms between them, and that such an extension "cannot therefore have existed." Moreover, the beautiful map of ocean depths with which the volume is illustrated shows a somewhat less depth than 2,000 fathoms on a slightly curved line between the islands, and I believe about the same depth exists between Madagascar and Africa, which have certainly at one time been joined.

There are some other matters touched upon on which I still venture to differ from my reviewer, especially as to the marvellous character of the Easter Island and other remains, and as to the value of the substitution of more for less liberal sectarian teaching in the Sandwich Islands; but on these points I have quoted authorities of considerable weight, and I leave my readers to form their own opinion. As to all matters of fact, I gladly accept correction from one who evidently writes with the advantage of a personal acquaintance with most of the countries referred to in his article. ALFRED R. WALLACE

Climatal Effects of Eccentricity

I AM grateful to Dr. Croll for noticing my letter. But I continue to think that if what seems to me to be the fundamental proposition of his theory, and which I quoted at the beginning of my former letter, be correct, and if the manner in which he and his reviewer have applied it be likewise correct, then we ought to find those differences in the *air* temperatures which my equations indicate. I say air-temperatures, because in Dr. Croll's theory changes of climate are referred to the varying distance of the sun, and climate depends on the temperature of the air.

The heating effect of the sun, other things being equal, has been hitherto assumed to be proportional to the excess of the temperature of the place above the temperature of space. A remarkable result which Pouillet had arrived at, and of which I was not aware when I wrote, shows that this method is incorrect. And I believe that what follows will to some extent afford a reply to the question which I have propounded, and at the same time have a proportionate bearing on Dr. Croll's theory. I quote Pouillet's words from the translation in Taylor's "Scientific Memoirs," vol. iv. p. 83.

"The total quantity of heat which space transmits in the course of a year to the earth and to the atmosphere . . . . would be capable of melting upon our globe a stratum of ice of 26 metres thickness. We have seen that the quantity of solar heat is expressed by a stratum of ice of 31 metres. Thus, together, the earth receives a quantity of heat represented by a stratum of ice of 57 metres; and the heat of space concurs in this for a quantity which is five-sixths of the solar heat. Between the tropics the heat of space is only two-thirds of the solar heat; for the latter is there represented by a stratum of ice of 39 metres."

These surprising results arise from the unequal absorption exercised by the atmosphere upon the heat rays proceeding from the stars and from the earth respectively.

It appears then, that, in applying Dr. Croll's proposition, we ought not to use the value of the temperature of space in forming our proportion, but we ought to use the temperature which the surface of the ground would assume were the sun extinguished. This Pouillet puts at -89°, or -128° F. The substitution of 128 for S., instead of 239, reduces my calculated difference between the January and July temperatures at the equator to 11° F., *i.e.*, by about one-half.

If we make the same correction in the case, the high eccentricity at aphelion, for which the *Quarterly Reviewer* has calculated the January temperature of England, and found it 3° F. (I make it even lower), the new temperature comes out 17° F., which can hardly be thought low enough to cause any extreme difference from the present climate. O. FISHER

October 25

THE statement quoted by Mr. Fisher from Dr. Croll (NATURE, vol. xx. p. 577) that "the temperature of a place, other things being equal, is proportional to the heat received from the sun," is based on the assumption of Newton's law of cooling, viz., that the rate of cooling of a body is proportional to the excess of its temperature above that of the surrounding medium. This is approximately true only when the excess is small. When the excess becomes large the rate of cooling augments much more than in proportion. The amount of heat which must be supplied to a body in order to maintain it above the temperature of the surrounding medium is proportional to what would be its rate of cooling. Hence this amount increases as the excess of temperature increases—proportionally while the excess remains small, but much more than proportionally when it becomes large. Conversely, the temperature increases more slowly than the amount of heat supplied, and any variation in the supply will affect the temperature produced in a degree which is less for a large excess than for a small one, and, therefore, less than Newton's rule would give. The excess of the earth's mean temperature above that of space is large, and consequently calculations of changes based on Newton's rule must be in excess of the truth.

The formula obtained by MM. Dulong and Petit (Stewart on "Heat," Art. 235) from the rate of cooling of a thermometer-bulb *in vacuo* makes the necessary supply of heat proportional to $(1{\cdot}0077^{t} - 1)$, where t is the excess of temperature in Centigrade degrees. If we apply this to the case of the earth, and take 80° F. as temperature at the equator when the earth is at its mean distance from the sun, then the resulting temperatures at its greatest and least distances with our present eccentricity, are given as about 74° and 85° respectively. The fluctuation, which Mr. Fisher makes 21°, is reduced to about 11°. The fall in temperature which would follow a stoppage of the Gulf Stream is made by Newton's rule 59° ("Climate and Time," p. 36): the more accurate formula reduces this to about 37°. Dr. Croll suggests that the temperature of space may be lower than is usually assumed (p. 37). If it be taken as absolute zero (-459° F.) the fall would not even then come out much greater than 45° F.

Several of Dr. Croll's tables should be similarly modified; at the same time it would be scarcely correct to say that these changes "touch Dr. Croll's theory somewhat closely." They do not invalidate the general contention, that a diminution of the Gulf Stream must diminish the mean temperature of northern regions to a very serious degree. E. HILL

St. John's College, Cambridge, October 25

The Weather and the Sun

PROF. PIAZZI SMYTH in his communication to NATURE, vol. xx. p. 431, evidently infers that changes in the condition of the sun must needs affect every part of the earth in the same way, whereas we have many meteorological analogies, which favour the notion that totally *opposite* effects may arise in different parts of the earth from the action of the *same* primary causes. For example, it is generally assumed that the same tropical heat which gives the primary impulse to the desiccating north-east trade wind of sub-tropical latitudes, furnishes the energy which exhibits itself in the almost constant precipitation under the equator. Any variation in the degree of this heat, should consequently affect localities situated in the region of the trades, and the equatorial calm-belt, in a diametrically opposite manner. Moreover, the notion that the British and Indian rain falls vary together now is altogether inconsistent with the well-known want of similarity between them, both as regards seasonal distribution and annual quantity in the past. It is also remarkable that while the present deluge both here and in India is traced to the sun's "*recovering* his forces and beginning already to shine after his recent languid spotless years with increased radiation on the great oceans of the south," the rainfall of England between latitudes 50° and 55° N. reached a decided maximum in 1877, the year when the sun was, to adopt the favourite metaphor, affected with the most extreme languor, and has been very high all through the period of unusually marked spot minimum, from which we are but just emerging.

The following figures from Mr. Glaisher's reports will illustrate what I have just said.

Great Britain, Lat. 50°—55° N.

Years.	Rainfall in inches.
1875	34·04
1876	34·60
1877	38·55
1878	32·61

More valuable results will generally accrue to science if, instead of founding vague hypotheses on a fancied likeness between isolated weather conditions, at places where the prime meteorological factors act in a totally dissimilar manner; induction is made from results which are derived from trustworthy data, and anticipated by a knowledge of admitted physical principles. As an example of this latter kind, allow me to conclude this letter by exhibiting to your readers a recently discovered regular secular period in one of the meteorological elements of Calcutta; a period too, (though this is at present a matter of secondary importance) which decidedly favours the reverse hypothesis to that entertained by Prof. Smyth regarding the variation of solar energy. The following figures have been worked out, and communicated to me, by Prof. S. A. Hill of Allahabad, and he has I believe given his conclusions from them and similar results, in a recent number of the Austrian *Zeitschrift für Meteorologie*, which, however, I have not as yet seen.

The table which follows, shows the annual range of mean monthly barometric pressure at Calcutta, from 1840 to 1878 inclusive, bloxamed in a series of eleven years, the average length of a sun-spot cycle, beginning with the year of sun-spot minimum.

Calcutta.

Years of cycle.		Annual range of mean monthly pressure in decimals of an inch.
11	Years of minimum sun-spot	·530
1		·549
2		·538
3	...	·510
4	...	·499
5	Years of maximum sun-spot	·502
6		·502
7	...	·500
8	...	·506
9	...	·512
10	...	·514
11	...	·530

The figures for Roorkee, from 1864 up to the present time, give a similar result. So far then as we have gone at present in India, we find years of few sun-spots characterised by higher temperatures, greater wind-velocity, and greater range of barometric pressure than those of many spots. The terrestrial effects of a "languid" sun are therefore strikingly like those of an unusually *hot* sun. E. DOUGLAS ARCHIBALD

Grosvenor House, Tunbridge Wells, October 18

Colour-Blindness

WHILE the subject of colour-blindness is before your readers, the present seems a favourable opportunity for calling attention to a method of experimenting which I used some years ago[1] for testing normal vision, and which seems, if applied to colour-blind eyes, likely to be capable of telling us something of the nature of that peculiar form of colour sensation.

When I made my experiments on normal eyes I intended extending the investigation to colour-blind eyes, but most unfortunately I was quite unable to find a true case of colour-blindness. All the cases reported to me proved, on examination, not to be produced by colour-blind eyes at all, but to be the result of want of observation and knowledge, as they all could distinguish between different colours, when placed alongside each other, and could also arrange the different colours, though when shown colours separately they made dreadful mistakes in naming them.

The method adopted in my experiments was as follows:—A prismatic spectrum was produced by passing a beam of light through a slit, a lens, and a bisulphide of carbon prism, in the usual way. The spectrum was thrown on a large number of rectangular reflectors, placed close to each other, and all capable of being moved so as to throw the light reflected from them to any point on a screen in front. With this apparatus we have the means of testing what colours can be produced by mixing others, and what colours cannot be so produced—by throwing the light reflected by one of the reflectors on the screen and trying if it is possible to match it by combinations of rays from other parts of the spectrum. It is found that for the normal eye the same sensation which is produced by the yellow part of the spectrum can be produced by mixtures of rays from the red and green parts, and also by rays from parts lying between these colours and yellow. And that the sensation which we call blue, can be produced by the blue part of the spectrum or by mixing rays from each side of the blue, that is by mixtures of violet and green. The yellow and blue are, however, the only two parts of the spectrum, the sensation of which can be imitated by combining rays from other parts of the spectrum. We cannot, for instance, produce green by any mixtures of rays from other parts of the spectrum. The red and the violet sensations are also incapable of being produced by mixtures.

These results are, to a certain extent, a proof of the threefold nature of our colour sensations. And they also show us that it is a mistake to talk of colours as simple and compound, as all the colours we find in nature are compounded of rays of many different rates of vibration. The difference between different colours is, those of one rate of vibration, say those of the D-line, even though absolutely pure, are capable of exciting a compound sensation, namely, the red and green, while mixtures of rays from each side of the line B, are only capable of giving rise to a simple sensation—namely, the red.

Supposing this three-sensation theory to be true, then there are certain conceivable variations of it which would give rise to colour-blindness. The blindness, for instance, might be produced by two of the three sensations being very similar. This does not seem improbable when we consider that, to any two persons, with normal eyes, the different colours will not necessarily appear equally different, and that, in the same normal eye, the different simple sensations are not separated by equal differences from each other. That is, supposing our sensations of the three primary colours to be represented by the three angles of a triangle, then the triangles, if drawn to the same scale, would be of different sizes for the eyes of different persons, and for almost all eyes the triangles would not be equilateral. The side between the green and the violet would be shorter than the other two, because the sensation of green is more similar to the sensation of violet, than green is to red or red is to violet. Or we might conceive the colour-blindness to be produced by the different sensations being irregularly, or by being too widely, distributed over the spectrum. If, for instance, the green sensation extended into the red part of the spectrum and the red sensation into the green part, that is, if the same rays excited both sensations in the same proportion, not only in certain parts, but throughout their entire range, then an eye, so constructed, would be incapable of distinguishing red from green. Another way in which colour-blindness might result, is by an absence of one of the three sensations.

It is impossible, without experimenting on colour-blind eyes, to say whether any of these, or some other, is the true cause of colour-blindness, and it is very desirable that some one, accustomed to make colour observations, would test colour-blind eyes in the way suggested; it would settle at once, for the particular eyes experimented on, whether they are badly defined trichroic eyes or are dichroic. If the eyes are dichroic, then, clearly, there will be only one part of the spectrum, the sensation of which can be produced by mixtures of rays from other parts, and not two as in trichroic vision.

Besides the apparatus described many others, more accurate, might be constructed, but the great advantage of this arrangement is, that it is suited for testing eyes not accustomed to make accurate observations or to be trammelled with elaborate apparatus. If Prof. Pole was to undertake the investigation, he could easily devise some simple apparatus to suit the experiments which, in his hands, would probably give some valuable results.

Darroch, Falkirk, October 7 JOHN AITKEN

[1] *Proceedings* of the Royal Scottish Society of Arts, 1871-2.

Subject-Indexes to the Royal Society Catalogue of Scientific Papers

As you have opened your columns to Mr. Garnett's valuable paper on "Subject-Indexes to Transactions of Learned Societies," you will perhaps allow me to make a suggestion in regard to the proposal contained in it. The initial objection to Mr. Garnett's scheme appears to me to be that the work he suggests will really be as large as the original catalogue, and, in fact, the same work in a new order. Even were it possible to get the money (probably little short of 10,000*l*.), the question would naturally arise whether or no the result was likely to be worth this great outlay. Moreover, the plan proposed by Mr. Garnett would not meet the great difficulty of compilation, which consists in the getting together of papers treating of identical subjects, but written with various titles by different persons. This would make it necessary to employ experts in each subject, and also a general practical editor for the whole, under whose eye all entries must pass. I cannot help thinking, therefore, with Mr. J. B. Bailey (p. 580), that the titles of the papers would have to be generally ignored.

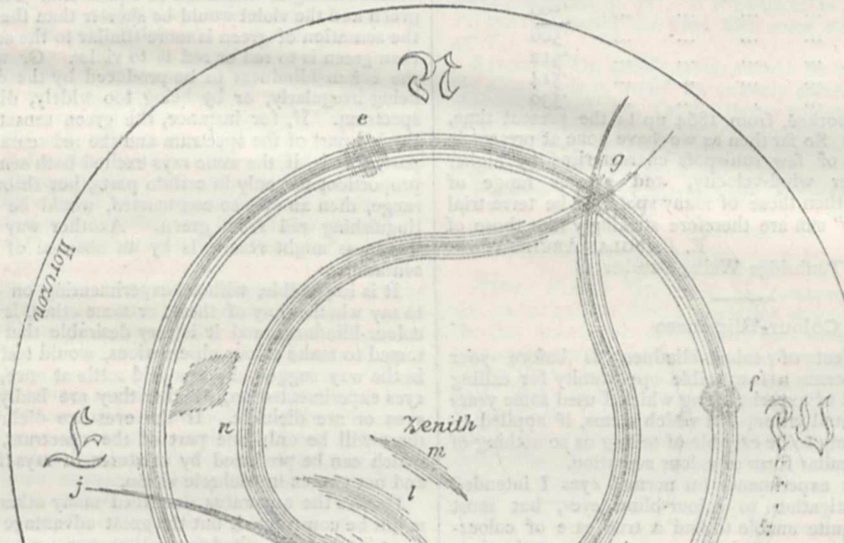
If the index were made as indexes to catalogues are usually compiled, it might be got into at least a third of the space of the original book, perhaps into a sixth. As to the need of such an index there cannot be two opinions. If, however, a fuller classified catalogue, such as is proposed by Mr. Garnett, be thought necessary, would it not be better to make it in the form of a series of indexes of separate subjects? The day for great encyclopædic works is nearly past, and as the astronomer cares little for the papers of the zoologist, and would find them only in his way, so both the zoologist and the astronomer would wish to have his own subject in a distinct volume.

This leads me to the chief point of this letter, which is to draw attention to the work that is already being done. I have received a letter from Prof. Holden, of the United States Naval Observatory, in which he announces to me, as Secretary of the Index Society, his intention of making an index to all the entries referring to astronomy in the Catalogue of Scientific Papers, and also informs me that Prof. Abbe, of the United States Signal Service and Weather Bureau, has a complete card catalogue of the meteorological entries in the Royal Society Catalogue. Probably other workers have done the same for other subjects. This is, I think, the best use to make of the Catalogue of Scientific Papers, which is of immense value, in the first place as a catalogue of authors, and secondly, as a collection of authentic documents from which a series of subject-indexes may be drawn.

Society of Arts, October 28 HENRY B. WHEATLEY

Solar Halo

I INCLOSE a sketch of a remarkable solar halo and parhelia which I observed here on the 22nd ult. As I happened to have facilities at hand, I was enabled to take the dimensions and position of the various features of the phenomenon with sufficient accuracy. These appearances were first seen by me at 9.30 A.M., and continued nearly constant in brilliancy till about 10 A.M., when they gradually faded, and at 10.30 hardly anything was visible except the outer ring, *abefg*, which continued till 1 P.M. At 9.45 the inclosed sketch was made and the measurements taken. The sun had then an altitude of about 30°, and was very misty and indistinct. It was surrounded by an ordinary solar halo of about 45° diameter; and through the sun passed another perfectly unbroken circle whose centre was exactly at the zenith. This circle had no colour and was similar in character to the ordinary concentric solar halo; its angular diameter was 120°; concentric with this was another circle of 78° diameter. This inner circle was not quite perfect at the point where the circle, *abcd*, touched it; it was slightly distorted, and through the same point (*d*) passed a portion of another circle of larger radius, *jk*. The junction of these three circles formed a beautiful spectrum, and was the most brilliant



part of the whole phenomenon. The inner circle was also imperfect on the side opposite the sun, when it branched off in two opposite curved tails, which, crossing the outer circle at the same spot, *g*, formed a mock sun. Two other mock suns were to be seen at *e* and *f*, 50° to each side of *g*. These three mock suns were all colourless, but at *a* and *b*, not on the concentric halo, but about 2° outside it, were two beautifully coloured mock suns, each being a perfect spectrum.

Finally, two portions of coloured circles were seen at *l* and *m*, with the concave side towards the sun, and two others at *n* and *o*, with their convex sides towards the sun, but in every case (both of circles and mock suns, *a* and *b*) the red colour was nearest the sun and the blue farthest from it.

I may mention, to give an idea of the brilliancy of the phenomenon, that many persons mistook one or other of the coloured bands for rainbows, and in one case one of the mock suns was supposed to be the sun itself (the sun happening to be hid from the observer by some adjacent buildings).

Dublin, October 11 HOWARD GRUBB

Karl Friedrich Mohr

IN your notice on the late Karl Friedrich Mohr there is no mention made of one of his most remarkable works, "Die Geschichte der Erde," the first edition of which appeared in 1866. In it he takes up what he considers entirely new ground and certain of his chapters are in the highest degree interesting. His chapter on the origin of coal is perhaps more interesting than any other, and is full of suggestive reasoning. I have not seen the work cited in any of our treatises on geology, and yet the opinions of such an eminent chemist must have some weight in the treatment of problems wherein chemistry alone can furnish a satisfactory solution. J. P. O'REILLY

Dublin, October 22

Suicide of Scorpions

THE self-destruction of the scorpion when hard-pressed is unquestionable. I have on several occasions invited sceptics to witness the tragedy (!) in this part of Europe.

The scorpion we frequently meet with in and about "Sierra Morena" under stones and in crevices, is a large light-brown species often more than *two* inches from head to sting.

Having procured one I have placed it in a circle of glowing charcoal embers a foot or so in diameter; after vain attempts to get away it raises its tail over its back, pierces its head with its sting and dies, precisely in the way described by Dr. Thomson (NATURE, vol. xx. p. 577). F. GILLMAN

Provincia Jaen, Linares, Spain, October 20

Superficial Earthquakes

CAN any correspondent oblige me with an explanation of the following facts? The earthquake which took place at Virginia City some time ago was not felt by the workmen in the mines. Some years ago a much more violent earthquake shook the town, breaking chimneys, overthrowing houses, and so on. But it was hardly to be noticed in the mines; indeed, not at all in the deeper shafts. E. BURKE, Jun.

October 16

Coloured Lightning

ABOUT 4 P.M. to-day we had a pretty severe thunderstorm, accompanied by heavy rain, and the entire heavens were overcast by one unbroken cloud; three or four flashes of lightning were of a distinct blue colour, and then followed a flash of beautiful rose colour, succeeded by more flashes of blue lightning. Will some of your correspondents explain the cause of change of colour? and oblige A CONSTANT READER

Welland, Ontario, Canada, September 28

"MEMORIA."—The correspondent who signs herself thus must send her name if she wishes her letter to be inserted.

OUR ASTRONOMICAL COLUMN

THE SATELLITES MIMAS AND HYPERION.—The following are approximate times of the greatest western elongations of *Mimas* during the first week in November:—

	h. m.			h. m.	
Nov. 1 ...	14 24	G.M.T.	Nov. 4 ...	10 15	G.M.T.
" 2 ...	13 1	"	" 5 ...	8 52	"
" 3 ...	11 38	"	" 6 ...	7 29	"

Observations of *Hyperion* during the present opposition are required before a reliable ephemeris of this satellite can be furnished. The true motion of the peri-saturnium is yet doubtful, unless Prof. Asaph Hall has been able to decide upon it from later observations than have been published. As we have stated before, Mr. Marth some years since conjectured that it might be as great as $+75°$ annually, and this rate of motion accords with Bond's determination of the place of the peri-saturnium in 1848 and Hall's results from Mr. Lassell's observations in 1852, and his own in 1875. So far as we know the Washington measures of 1878 are not yet published; probably they may throw more light upon the subject.

ANUARIO DEL OBSERVATORIO DE MADRID.—The seventeenth volume of this compilation (for 1879) reaches us late in the year. It is one of those useful compendiums of which the *Annuaire du Bureau des Longitudes* is probably the oldest, and may be taken as the type. Astronomical phenomena and details occupy a considerable space, and the volume is therefore fitly noticed in this column, but there is a great amount of miscellaneous information, geographical, meteorological, physical, and otherwise, which will recommend it to a larger class of readers. We remark some few points to which exception might be taken on the score of want of accuracy or completeness; thus the independent discovery of *Hyperion* by Mr. Lassell is not recorded, and the number of Uranian satellites is set down as eight, though four are queried with good reason. The discovery of Tuttle's comet is dated in 1858, no mention being made of its appearance in 1790. It is doubtless through a misprint that Encke's comet is stated to have appeared in 1695. Many of the miscellaneous tables are very full, as, for example, those of the altitudes of mountains in all parts of the world, the length of rivers, and the meteorological conditions in various parts of the peninsula, and as regards Spanish science, &c., the volume is no doubt to be considered authoritative. There are many who have occasion to consult works of this kind, who may like to have their attention directed to the present publication of the Royal Observatory at Madrid.

A NEW PRIVATE OBSERVATORY.—Observatories erected, equipped, and maintained in activity by private individuals are numerous in this country, and, as will appear from Prof. Holden's recent report, there are many of them in the United States; but the number of known observatories of this class upon the continent of Europe is not great, and the more interest therefore attaches to the addition of a new one to the list. Dr. Jedrzejewicz gives some account of an observatory he has constructed at Plónsk, about 37 miles from Warsaw, or in lat. 52° 37′ 39″, and long. 20° 30′ 59″ E. of Greenwich. The principal instrument is an equatorially-mounted refractor by Steinheil, of 6·4 inches aperture, to which are attached filar and other micrometers, and a spectroscope. Acting upon the advice of Dr. Vogel of Potsdam, Dr. Jedrzejewicz has the intention of devoting his time mainly to the measurement of double-stars, selecting such objects as are well within the power of his telescope; indeed, he has already made a considerable advance in this direction, having secured 860 complete observations of 170 double or compound stars, the result of some 8,500 separate measures, and with the view to enable astronomers to judge of the amount of confidence to be placed in the observations that may be published from Plónsk, he has given a comparison of his measures of a number of stars, which do not exhibit change, with those of Struve and others, and the comparison will tend to induce reliance upon his work. One remark we may make which bears generally upon the selection of objects for measurement with such an aperture as Dr. Jedrzejewicz possesses: it appears to have been too much the custom with the generality of observers who devote themselves to double-star astronomy, to accumulate a large number of measures of well-known, we may almost say, historical binaries, to the neglect of other objects, equally within the scope of their instruments, and equally deserving of attention. A carefully-considered list of stars is an essential in the actual state of this branch of the science, if the labours of the observer are to possess their utmost attainable value, in the future. The numerous discoveries of Mr. Burnham in particular confirm us in this view; his various lists exhibit many stars which it is highly desirable to keep under observation, and which do not yield in point of interest to other better-known binaries.

GEOGRAPHICAL NOTES

THE Japan papers report, with expressions of great regret, the loss, of which we have already had news by telegraph, of the *A. E. Nordenskjöld*, the little vessel which M. Sibiriakof fitted out for the relief of the *Vega*. The vessel left Yokohama on August 1, and was lost on August 5, near Nemora, at the north-eastern point of the island of Yesso. The *A. E. Nordenskjöld* was commanded by Capt. Sengstake, an Arctic explorer of repute, who, when called to this duty, had arranged to accompany Dr. Otto Finsch in his expedition to the Pacific. The crew consisted of picked Arctic sailors, and there were also on board M. Gregorief, representing the Russian Geographical Society, and Herr Dankelmann, of Leipsic, the delegate of the Bremen Society. All on board were saved and were stated to be returning to Yokohama.

DR. OSCAR LENZ will shortly start on a tour to Marocco by order of the German African Society.

Les Missions Catholiques has published, in its last two numbers, some notes on Assam and the neighbouring countries, which have been furnished by a Roman Catholic missionary. By a singular coincidence the second instalment, containing an account of the Naga tribes, appeared just at the time when news arrived of Mr. Damant's murder in the Naga Hills.

THE new *Bulletin* of the Société de Géographie Commerciale, of Bordeaux, contains a paper of some interest, by M. G. Revoil, entitled "Le Pays des Çomalis-Medjourtines," which is accompanied by an outline map of that portion of Africa.

THE members of the Geographical Society of Algiers held their first meeting in the Hotel de Ville of that city on October 22, to elect their officers.

THE just-published *Bulletin* (for August) of the Paris Geographical Society, contains the itinerary of the Abbé Desgodins, of his journey from Pa-tang to Ta-tsien-len and back in 1877, and an account of the journeys of Père Duparquet in South Africa, by the Abbé Durand. There are some interesting letters between Dr. Rohlfs, Dr. Stecker, M. Duveyrier, and M. Marié Davy, concerning observations made in North Africa by Dr. Stecker, on electrical and other natural phenomena.

MR. STANFORD has just published a large scale map of Japan, which forms probably the best map of the country now in existence. It has been compiled by Mr. Knipping, whose official position in Japan has given him exceptional advantages for obtaining the necessary material. He has used the native Japanese surveys, which we believe are wonderfully accurate, data collected during his own extensive journeys in the country, travellers' narratives, and consular reports. The map is on the scale of seventeen miles to an inch, and is creditable to author and publisher, and certain to prove useful to all who have dealings with the country.

MR. EDWARD F. SANDEMAN will shortly publish, through Messrs. Griffin and Farran, an account of his travels in South Africa, under the title of "Ten Months in an Ox Waggon; Reminiscences of Boer Life." A special feature of the book will be the description of the home life of the Boers and their chief characteristics, and it will contain half-a-dozen chapters of shooting experiences in the country to the far east of the Transvaal, with accounts of the various big game of that region. A visit to the gold fields is also described, and some account will be given of the life of the miners. The volume will contain a map of the country.

KEW GARDENS

IT is highly desirable that the public should be fully acquainted with the real objects of the establishment of which we have the annual report before us,[1] as a very imperfect impression on the subject is prevalent. That object is not simply to collect as many forms of vegetation as admit of cultivation, with a view to facilitate the studies of botanists, whether young or old, much less to make mere collections of plants without any ulterior view; but while its unequalled herbarium and diligent staff are enabled to promote botany as a science, it has in view the rational recreation of multitudes and the accompanying improvement in taste, from the familiarity with exquisite forms and combination of colouring, aided by the attendant prevalence of order in each department; while in an economic point of view there are facilities for the investigation of diseases which affect our commerce or manufactures, unequalled facilities of diffusing through our colonies productions which may prove of vast importance to their interests, inquirers at home being able at once, through the museum and its curator, to become acquainted with matters in which their factories are more or less concerned, and thus to obtain information which in many cases has proved the source of national advantage. At the same time there are great opportunities for young cultivators gaining such a knowledge of the structure and intimate nature of plants as will not only be useful to themselves and their employers, but which has a tendency to improve by example the numerous tribe of gardeners who are too often deficient in the very knowledge which is of the utmost importance to successful cultivation. The interchange of plants and seeds also is carried on to a great extent at Kew, which is now the acknowledged ultimate medium for all communications from abroad with reference to what may be called industrial plants. The mass of correspondence which is carried on in this very useful department is almost overwhelming. Amongst other things, india-rubber plants, coffee, and quinine-producing barks, have received peculiar attention, respecting which interesting details will be found in the report. The cinchona plantations, not less than those of coffee, are every day of increasing importance, much of which is due to our national establishment at Kew. Not only have pains been taken to introduce the most improved forms of the coffee-plant, but the disease which is ravaging the coffee-plantations in Ceylon has been diligently studied by Mr. Abbay, whose observations were commenced in Ceylon in company with Mr. Thwaites. The first step to combating with diseases is doubtless an efficient knowlege of their nature, and it appears that the observations of these gentlemen and Mr. Morris have been attended with success in the application of proper remedies. Full figures are given in the report of the structure and nature of the coffee mildew by Mr. Abbay. This is not the only good work which has been done at the new laboratory during the past year, where the writer of the present notice has more than once profited by the facilities which it affords for observation.

It is not to be expected that the introduction of useful plants will be equally successful everywhere. Much depends on the intelligence and care of the recipients, even when there is no inaptability of climate. We anticipate in future reports that the diffusion of other matters less generally known will be recorded as at once successful and important. There is, perhaps, no set of plants of more importance than those which produce india-rubber. Attention was drawn years ago to the wasteful destruction of native plants and the necessity of greater care being taken with the forests in which these trees abound, and a committee was appointed for the furtherance of this object. The trees which produce this valuable substance are various, and belong to very different natural orders, and the extension of different sources of production, in consonance with different varieties of climate, has been a matter of constant anxiety at Kew. Here, again, a perusal of the report before us will be highly instructive.

Besides the matters above mentioned, at the close of the report many suggestions of sources of possible utility are given, which will be read with much interest, amongst which we may mention the Rain-tree of Peru, the South

[1] "Report of the Progress and Condition of the Royal Gardens at Kew during the Year 1878."

African Bamboo, the Sugar-Cane Disease, Substitutes for Vegetable Ivory, and Paper Materials.

As regards the plants under cultivation, it should be stated that great pains are taken to name them conspicuously and correctly, a matter of extreme importance to students, and one which every day engages the unwearied attention of the staff at the Herbarium. Without almost unlimited means the collection could scarcely be much extended. The admission, however, of Mr. Peacock's unequalled collection of succulent plants for a limited but sufficiently extended period should not be passed without notice. The proposal was a happy one, and the acceptance much to the credit of the authorities. The groups of hardy economic plants and of those of a similar character which require a higher temperature than our country can offer are of especial interest to the student. The plants of peculiar botanical importance which have flowered during the past year are duly recorded, while an especial report, accompanied by a figure, is devoted to a new tropical fodder-grass which grew and flowered under store treatment. At Singapore, Adelaide, and elsewhere the hopes conceived of it are very great, and seeds of it have been widely distributed from Kew. Nor are matters of cognate interest at home neglected. A notice is given of that form of the prickly comfrey which is likely to be a valuable fodder plant in Great Britain and Ireland. It seems to be a hybrid between *Symphytum officinale* and *S. asperrimum;* we have seen it lately in great perfection and in full usage, where it is greedily consumed by cattle, which thrive upon it immensely, while they will not touch the common comfrey.

The ravages of insects amongst plants are of no less interest than those which are produced by fungi. A very small bug, for example, is highly detrimental to the tea plantations in India, and Mr. McLachlan has given a great deal of valuable information on such subjects, information of such importance that the want is suggested of a consulting entomologist, at the disposal of the different Government offices, who should receive a retaining fee in return for investigating and reporting upon the various questions respecting which the residents in our various British dependencies apply for information.

At the commencement of the report there is a notice of the condition of the tropical fern house as regards the decay of the rafters, which the late storm has too sadly confirmed, and it is in consequence suggested that some hard wood like teak or blue gum should be substituted. The suggestion is one of great importance to all who are interested in the sustentation of their stoves and conservatories. Foreign deal is often dangerous. Every one who has watched the progress of decay in imported wood as used in railway construction, must have seen how soon they become infested with such fungi as *Lentinus lepideus, Trametes pini*, and *Lenzites sepiaria*, of course, from spawn contained in the wood. But home-grown wood is no less subject to decay from fungi. Where oak is grown from old stools, the wood is apt to have a tint, which, to persons well skilled in such matters is known as foxy. Such wood would at once be rejected in our naval yards, but we have seen a case in which it was used in the construction of a range of hothouses, where the whole in a few years was destroyed by *Dædalea quercina;* and deal, whether of home or foreign growth, is soon infested with *Polyporus medulla panis*, which is, we believe, a condition of one of our commonest fungi. It is not always possible to say whether any mycelium is present in wood; it is better, therefore, as Sir Joseph Hooker suggests, to use some material less liable to decay.

It remains only to notice the acquisitions to the herbarium during the past year. One of the most important is a collection of fungi containing more than 10,000 species, a great portion of which are typical. That of Mr. Dazell is important from its containing type specimens of the Bombay flora. Messrs. Cosson, Miers, and Casimir De Candolle have sent collections of greater or less magnitude and value, while the list of contributors either in specimens or drawings occupies more than three columns. The botanical publications prepared in connection with the work of the herbarium have been of an importance equal to that of former years, while the third volume of Hooker and Bentham's Genera now in the course of printing, is the result in great measure of last year's studies, which have never wavered.

M. J. BERKELEY

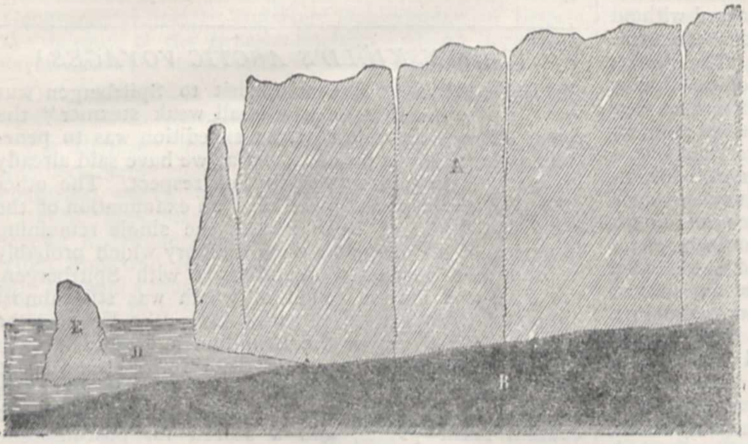
NORDENSKJÖLD'S ARCTIC VOYAGES[1]

NORDENSKJÖLD'S next visit to Spitzbergen was made in 1868, in a "small weak steamer" the *Sofia*. The main object of the expedition was to penetrate as far north as possible, but as we have said already it was not very successful in this respect. The other objects of the expedition included an examination of the flora and fauna of Bear Island, the single remaining fragment of an extensive polar territory which probably at one time connected Scandinavia with Spitzbergen, the flora and marine fauna of which was still almost unknown, though fitted to throw important light on the animal life not only of the Scandinavian peninsula, but also of the northern shores of Britain which are washed by the Gulf Stream; a careful examination of the strata on Bear Island and at Ice Fjord and King's Bay which contain fossil plants, and a search for post-miocene strata on the peninsula between Bell Sound and Ice Fjord, which might afford some information as to the transition from the warm climate of the miocene period, which produced a luxuriant forest vegetation, to the ice masses of the present time; a more thorough examination of the Saurian strata at Cape Thorsden; an examination of the fragments of skeletons of whales found on the shores of Spitzbergen; a continuation of the collection and examination of the land and marine fauna and flora; dredgings at the greatest depths; magnetic and meteorological observations; geographical determinations of position, &c.

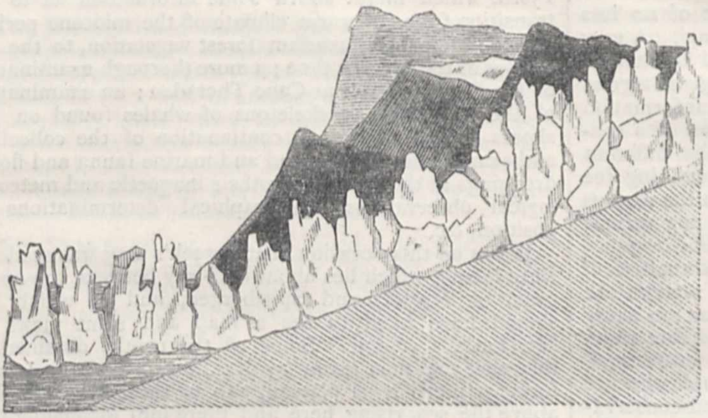
It was on this occasion that a week's stay was made at Bear Island, which lies about half-way between the north coast of Norway and Spitzbergen, and of which we should have liked to see a map and some views in Mr. Leslie's volume. Some of the results obtained in this visit are thus given by Mr. Leslie:—"Bear Island forms a pretty level plateau, two to three hundred feet above the sea, rising here and there into inconsiderable elevations and furrowed by small valleys, in the bottoms of which little streamlets seek their way among the naked stones. In the south-east the appropriately named Mount Misery rises perpendicularly from the sea to a height of about 1,200 feet, and in the south the Fuglefjeld is about the same height. On neither of these, however, is there any glacier or perpetual snow. It is not the formation of the island which gives it so desolate and forbidding an appearance, but the monotonous grey colour of the whole landscape. No trace of any grass turf is to be found in the interior, far less of any trees or bushes; only the Polar willow (*Salix polaris* and *herbacea*) with its thread-like stalks creeping in the moss, and two or three leaves, scarcely the size of a finger-nail, raised above it. Green patches in hollows where water has collected and formed a sort of marsh consist principally of mosses with scattered specimens of the Polar ranunculus (*Ranunculus sulphureus*) and a few other plants and grasses sparingly mixed with them. Except in these marshy places, the ground is nearly everywhere without the slightest trace of covering. By the combined action of water and frost the rocks have been literally frozen

[1] "The Arctic Voyages of Adolf Erik Nordenskjöld, 1858–1879." With Illustrations and Maps. (London: Macmillan and Co., 1879.) Continued from p. 611.

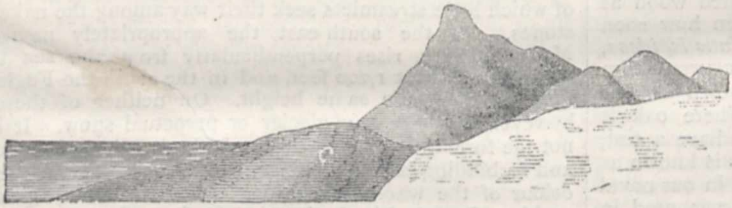
asunder, the limestone to small angular fragments, and the sandstone to larger or smaller blocks heaped one upon another. Such collections of stones cannot of course afford nourishment to higher plants, the more especially as any little mould that may be formed is immediately swept away by the wind or washed away by the rain. At long intervals in this wilderness of gravel and limestone there are found solitary specimens of the Arctic poppy (*Papaver nudicaule*), *Saxifraga*, *Draba*,



I.



II.



III.

I. Inland Ice (A) extending into the Sea (D) and terminating in a steep front, 100 to 200 feet high. II. Inland Ice abutting on the bottom of an Ice-fjord, *i.e.*, a Fjord in which real Icebergs are formed. III. Inland Ice abutting on a Mud-bank.

Sagina, &c. Lichens, especially the larger species, occur here very sparingly and badly developed, though in spots the ground is almost covered by species which are exceedingly rare in the flora of Scandinavia. Where sandstone is the prevailing rock, the view is still more unpleasing. There is a considerable extent of surface where the only method of progression is by jumping from one block of stone to another, from which blocks all the higher plants, with the exception of a grass or two, are banished. The exterior of the island is more attractive. The rocks rise perpendicularly out of the sea, and as they consist of the looser formations, they have, in course of time, been shaped by the waves into the forms of arches, grottos, towers, columns, &c. The projecting rocky promontories are in some places found to be clothed with turf, and the perpendicular cliffs are richly hung with luxuriant *Cochlearia*.

"The explanation is easy. It is only the ledges where the sea-fowl sit that are thus ornamented, and it is only in the rich mould originating from these fowl that the plants can attain such luxuriance. This leads us to the most remarkable thing about Bear Island, its fabulous richness in sea-fowl. Indeed it may be said that the fowl are the proper inhabitants and owners of the island. There are, it is true, some mountain foxes, but they are very scarce, and the greater number only make a visit during winter, resembling in this the Polar bear, from which the island is named, as it cannot, at least now, support itself here in summer. During that season the walrus, which soon after the discovery of the island was found upon its shores in unheard-of numbers, and a little flock of which Keilhau had an opportunity of observing, is now sought for in vain. Even in winter, according to the latest observations, the Polar bear is an unusual guest here. . . .

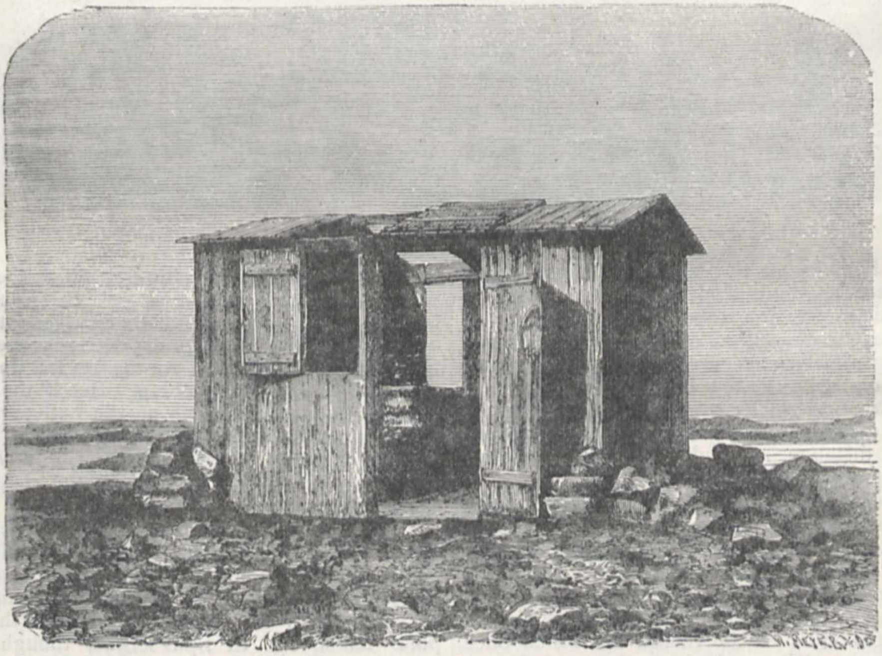
"The number of plants found by the botanists of the expedition was thirty-three, which, with the other five formerly observed, but not now found, makes the whole number of phanerogamous and higher cryptogamous plants found on Bear Island thirty-eight. The number of species of insects found was twelve. The number of marine animals was unexpectedly small in consequence of the unsuitable nature of the bottom. A great part of the island consists of strata belonging to the Mountain Limestone, in which are found in abundance mussel shells, corals, &c., showing that in times long past quite a different animal world lived in an almost tropical ocean. Two and a half centuries ago seams of coal were discovered on the north coast of the island, showing as black parallel bands on the perpendicular cliffs facing the sea. As the coal that occurs on Spitzbergen had been proved by the preceding Swedish expeditions to belong to the comparatively recent tertiary period, it had been considered probable that this was the case also with that found on Bear Island. But on examination being made impressions of plants were found, partly in the coal, partly in the sandstone separating the seams, which afforded indisputable evidence that the strata here belong to the true coal formation. Splendid *Sigillaria*, *Lepidodendra*, *Calamites*, and other characteristic fossils of the Coal period were taken, not without danger to life, from the perpendicular sea-cliffs on the north side of the island, and it was with deep regret that others had to be left behind because there was not time to cut them out of the rock."

Ice Fjord was again explored and much new geological data obtained, and various parts of the north coast examined. Of this expedition, the distinguished *savant*, Prof. Oswald Heer of Zürich, declared—"In my opinion the Swedish Expedition, by the rich collections it has brought home, has achieved more, and more widened the horizon of our knowledge, than if it had returned merely with the information that the *Sofia* had hoisted her flag at the North Pole."

Nordenskjöld's last expedition to Spitzbergen was made in 1872-3, when a winter was passed in the island, with the intention of pushing north by the Seven Islands by means of sledges. As a preleminary to this, he paid a visit to Greenland in 1870, for the purpose of ascertaining

Glacier in Fair Haven.

the suitability of the Eskimo dog for sledging purposes. After careful observation Nordenskjöld came to the conclusion that reindeer were much better adapted to the work than dogs, and so it was decided to use the former in the contemplated expedition. While in Greenland Nordenskjöld made a journey of a few days into the interior and brought back some interesting results. He succeeded in penetrating only a distance of thirty miles,



Astronomical Observatory at Mussel Bay.

and that with great difficulty on account of the rough nature of the inland ice and the frequent crevasses that had to be passed.

"On the surface of the inland ice no stones were met with at a distance of more than a cable's length from the border; but everywhere there were to be found vertical cylindrical holes, a foot or two deep, from a couple of lines to a couple of feet in diameter and so close to one another that it was impossible to find between them room for the foot, much less for a sleeping sack. . . . In these holes in the ice, filled with water and in no way connected with each other, Nordenskjöld found everywhere at the bottom of them, not only at the border but in the most distant parts of the inland ice which he visited, a layer some few millimetres thick, of grey powder, often conglomerated into small round balls of loose consistency. Under the microscope the principal substance of this remarkable powder appeared to consist of white angular translucent grains. There could also be observed remains of vegetable fragments; yellow, imperfectly translucent particles, with, as it appeared, evident surfaces of cleavage, possibly felspar, green crystals (augite), and black opaque grains, which were attracted by the magnet. 'The substance,' says Nordenskjöld, 'is not a clay, but a sandy trachytic mineral, of a composition (especially as regards soda) which indicates that it does not originate in the granite region of Greenland. Its origin appears to me, therefore, very enigmatical. Does it come from the basalt region? or from the supposed volcanic tracts in the interior of Greenland? or is it of meteoric origin? The octahedrally crystallised magnetic particles do not contain any traces of nickel. As the principal ingredient corresponds to a determinate chemical formula $(2R\dot{S}i^{2} + \ddot{A}l\,\dot{S}i^{3} + H)$, it would perhaps be desirable to enter it under a separate class in the register of science; and for that purpose I propose for this substance the name Kryokonite (from *κρύος* and *κόνις*). 'When I persuaded our botanist Dr. Berggren, to accompany me in the journey over the ice,' he continues, 'I joked with him on the singularity of a botanist making an excursion into a tract, perhaps the only one in the world, that was a perfect desert as regards botany. This expectation was, however, not confirmed. Dr. Berggren's keen eye soon discovered, partly on the surface of the ice, partly in the above-mentioned powder, a brown polycellular alga, which, small as it is, together with the powder and certain other microscopic organisms by which it is accompanied, is the most dangerous enemy to the mass of ice, so many thousand feet in height and hundreds miles in extent. This plant has no doubt played the same part in our country, and we have it to thank, perhaps, that the deserts of ice which formerly covered the whole of northern Europe and America have now given place to shady woods and undulating cornfields. Of course a great deal of the grey powder is carried down in the

Canal in the Ice of North-East Land.

rivers, and the blue ice at the bottom of them is not unfrequently concealed by a dark dust. How rich this mass is in organic matter is proved by this circumstance among others, that the quantity of organic matter in it was sufficient to bring a large collection of the grey powder, which had been carried away to a distant part of the ice by several now dried-up glacier streams, into so advanced a state of fermentation or putrefaction, that the mass, even at a great distance, emitted a most disagreeable smell, like that of butyric acid.' "

The land gradually rose, and at their turning-point they had reached a height of 2,200 feet above the sea. During this visit to Greenland Prof. Nordenskjöld made some interesting observations on glaciers. "It is," he says, "a common error among geologists to consider the Swiss glaciers as representing on a small scale the inland ice of Greenland, or the inland ice which once covered Scandinavia. The real glacier bears the same relation to inland ice which a rapid river or brook does to an extensive and calm lake. While the glacier is in perpetual motion, the inland ice, like the water of a lake, is comparatively at rest, excepting at those places where it streams out into the sea by vast but short glaciers. If one of these glaciers, through which the ice-lake falls out into the sea, pass over smooth ground where the bottom of the ocean gradually changes into land without any steep breaks, steep precipitous glaciers are produced from which indeed large ice-masses fall down, but do not give rise to any real iceberg. But if the mouth of the fjord be narrow, the depth of the outlying sea great, and the inclination of the shore considerable, the result will be one of those magnificent ice fjords which Rink so admirably describes. No. II. in the diagram on p. 632 illustrates this more clearly.

"True icebergs are formed only in those glaciers which terminate in the manner indicated in No. II., though pieces of ice of considerable dimensions may fall from a steep precipice (No. I.). These various kinds of glaciers occur not only in Greenland, but in other ice-covered polar lands, *e.g.* in Spitzbergen, though on so much smaller a scale than in Greenland that one never meets in the surrounding waters with icebergs at all comparable in magnitude with those of Davis Straits.

"In Spitzbergen, and probably also in some parts of Greenland, the ice passes into the sea, as in No. III.

It was in this expedition that Nordenskjöld obtained the two famous meteors, one of which, weighing nineteen tons is now in the Riks-Museum at Stockholm, and the other, nine tons, in the Museum of Copenhagen.

For the expedition of 1872-3 the Swedish government provided a steamer, the *Polhem*, and a brig, the *Gladan*, which were accompanied by the *Onkel Adam* as tender. Tromsö was left on July 30, and Ice Fjord was again visited, where a search was made in Coal Bay. Some little time was spent at Fair Haven, on the north of the island with the view of finding the place where the Dwarf Birch had been discovered in 1870 by Nathorst and Wilander. After a long fruitless search, and when all hope of finding it was given up and the return to the boat commenced, its dark green leaves were at last observed projecting from the surrounding moss. The dwarf birch found here, the *Betula nana, var. relicta*, TH. FRIES, is believed to be a survival from the time when Spitzbergen possessed a finer and warmer climate than now. Its height, as found here, did not exceed two feet, the thickest stem being from two to three lines in diameter. After the return to Sweden it was found by the help of the microscope that a stem of this thickness was about eighty years old. The yearly rings were exceedingly thin and faintly marked in several specimens, and in some parts of the stem, altogether indistinguishable. A well grown beautifully flowering specimen of the *Cardamine pratensis* also rewarded the search of the botanist, a *find* which was specially welcome, because this plant, though pretty widely distributed, is seldom found in flower on Spitzbergen.

Leaving Green Harbour on August 4, the *Polhem* proceeded on her voyage with the *Gladan* in tow, passing through the sound between Prince Charles Foreland and the mainland and anchoring on the 7th in Fair Haven for the purpose of regulating the chronometers at the place where Sabine and his companions spent three weeks in 1823, carrying on a series of physical and astronomical observations. The place which is situated on the south-western shore of the inner Norway island still bears the name of Sabine's observatory, and is distinguished by a great number of stones collected in a circle. While here, Wijkander carried on a series of magnetic observations at Sabine's observatory. Astronomical observations were also made, and two and sometimes three boats were at work dredging from morning till night. It ought also to be mentioned that on the drift-ice which the *Polhem* had encountered a short time before, Nordenskjöld had found small quantities of dust similar to that which he had discovered in the snow during a snow-storm at Stockholm in December 1871. This dust, which he believes to be of cosmic origin, contains metallic iron, cobalt, nickel, phosphoric acid, and a colloid organic substance. "However small and inconsiderable the quantity of this substance may be in proportion to the snow or water falling at the same time," he writes, "it may yet play an important part in the economy of nature; for example, by means of the phosphoric acid which it contains it may restore the fertility of the soil impoverished by repeated harvests. This observation ought also to be of great importance for the theory of meteors of the aurora, &c. Perhaps we should inquire whether in this phenomenon we are to seek the explanation of the abundance in which magnesia, which occurs plentifully in meteorites, is found to exist in certain distinct geological districts, and if an increase of the earth's mass, which is certainly minute, but which is going on continuously, ought not to produce very considerable changes in the geological theories now prevailing, which proceed on the supposition that the globe is as nearly as possible unaltered in mass since the first occurrence of plants and animals, and that the geological changes have always depended on changes of distribution in the mass over the surface of the earth, never upon the arrival from without of new constructive material for our globe."

While at Fair Haven the expedition was visited by Mr. Leigh Smith in his yacht, who promised that he would be among the first to look them up next summer. After a long enforced delay in Fair Haven on account of the ice, the expedition got away in September 1, but failed in every attempt to reach the Seven Islands. Mussel Bay, then, a small inlet off the east side of the mouth of Wijde Bay was chosen as the winter quarters of the expedition, and here all three vessels were ultimately locked in the ice. One large building was erected on shore besides magnetical, meteorological, and astronomical observatories. During the whole of the stay of the expedition here regular observations were carried on in their observatories. Provisions were short, and all had to be put on allowances; though scurvy broke out there was only one death, and altogether the winter was a dreary one, in spite of every effort to keep officers and men constantly employed.

Wijkander remained whole nights in his observatory bravely defying the cold and patiently overcoming the many difficulties attending astronomical observations made in such circumstances. In the cold weather the work out of doors was not stopped and the dredgings still went on, it being of great importance to ascertain whether the severe cold and the long darkness exercised any special influence upon the marine animal and vegetable world.

With the arrival of spring preparations were made for the ice-journey to the north, but as we have said already they did not get beyond the Seven Islands. Nordenskjöld makes some interesting observations on the rugged ice which prevented him attempting to push further northwards. "The ice we thus passed is formed not of colossal blocks or icebergs, but of angular blocks of ice, *not waterworn*, piled loosely over each other, so as to form pyramids, or walls of ice, up to thirty feet high, which were so close to each other that the space between them was frequently not large enough for our tent. The cause of the formation of these ice-walls, which were also observed by Wrangel on the north coast of Siberia, is probably to be sought for in the changes of volume which ice undergoes when its temperature is changed. According to Plücker and Geissler, the linear expansion-coefficient of ice is = 0·0000528. If, therefore, ice of 0° C. be cooled to – 15° C., cracks must arise which, for 1,000 metres, have a breadth of 32 inches. The cracks naturally freeze together immediately afterwards, and when the ice is again warmed, for instance to – 5° C., a piling-up must take place of 21 inches per kilometre. During the course of the winter this phenomenon is repeated innumerable times, one layer of ice being piled upon another, till the whole ice-field forms a confused mass of blocks of ice heaped up against each other. Similar forces are also in operation in the crust of the earth, with less intensity, indeed, in consequence of the smaller expansion-coefficient of the rocks which compose it, and the inconsiderableness of the changes of temperature which occur in them, and the cracks thus formed may here come together again, provided no chemical or mechanical sediment has been deposited in them, as is, perhaps, often the case. On the other hand, the forces operate in the earth's crust during millions of years, and I doubt not that in the circumstances here noticed the cause of the strata being contorted, dislocated, *and thrown over each other* is to be sought for. This last, perhaps, to judge by the observations I had the opportunity of making on the polar ice, happens far oftener than we commonly suppose, and when it takes place there often occurs no considerable disturbance in the original horizontal position of the stratum. Certainly in most cases the veins filled with foreign minerals, by which the upper strata of the earth in particular are intersected in all directions, derive their origin from similar causes; that is to say, from cracks which have in consequence of changes of temperature many times over opened and come together again, *provided they were not prevented by the falling in of débris*. This has, however, often taken place, considerable masses of sediments, formed chemically or mechanically, have frequently collected in the cracks, and during the immense duration of geological ages they have hardened and been metamorphosed to solid crystalline rocks—limestone, quartz, felsite, pegmatite, &c."

To make up for the disappointment of not being able to push beyond the Seven Islands, Nordenskjöld made a journey round the coast of North East Land, and right across the island from east to west. "North East Land," he tells us, "forms the most northerly of the four large islands, into which Spitzbergen is divided. Its extent from north to south is seventy-five and from east to west about ninety-two geographical miles. The whole interior is occupied by an ice-sheet 2,000 to 3,000 feet thick, to which the fall of snow (and rain) during summer and winter brings new material and which accordingly would be unceasingly increased, if the mass of ice did not, as is the case with all glaciers, flow out into the sea slowly but without intermission. The principal direction of the ice-stream in North East Land is towards the east, and the whole of the east coast is therefore occupied by a single precipitous ice-wall, insurmountable from the sea, which, being nowhere interrupted by rocky heights or tongues of land, forms the broadest glacier or skridjökel known to man. It is, for instance, considerably broader than the Humboldt glacier in Greenland described in such lively colours by Kane. Northwards, however, the ice-sheet of North East Land terminates with an even and gentle slope, which sometimes reaches the sea, but generally leaves a small stretch of ice-free land along the coast. On this side there is no obstacle to an advance into the interior, at least from precipitous slopes."

With regard to the glaciers which cover the surface of this island, Nordenskjöld writes :—

"Like the glaciers of Switzerland, of Greenland, and of Scandinavia, the glaciers of Spitzbergen are interrupted by clefts or fissures which often extend perpendicularly through the whole mass of ice several thousand feet thick. The occurrence of these fissures stands in close connection to the motion of the glacier, and there is therefore a smaller number to be met with where the glacier is spread over an extensive level field without interruption from rocky heights. Accordingly we had reason to suppose that clefts or fissures would not in any specially great number intersect the way we had chosen and I hoped besides that all the crevasses would have been filled with snow during the snow-storms of winter. This supposition was so far correct, inasmuch as fissures do not here occur in such numbers or of such size as in that part of the inland ice of Greenland which I examined along with Dr. Berggren in 1870—but deep almost bottomless openings do nevertheless occur in numbers sufficiently large to swallow up us and our sledges. They were the more dangerous as they were for the most part concealed by a fragile vault of snow, so that even when we stood on the edge of the cleft, it was only by boring with an ironshod stick, very often first by ourselves falling in, that we could assure ourselves of neighbourhood, direction, and extent."

In spite, however, of the innumerable concealed crevasses which they had to pass, the journey across the glacier-bound island was safely accomplished. The snow, he found, at a depth of four to six feet, passes into ice, being changed first to a stratum of ice-crystals, partly large and beautiful to the eye of the crystallographer, then to a crystalline mass of ice, and finally to a hard homogeneous glacier ice, in which, however, there could still be observed numerous cavities filled with air, compressed by the pressure of the overlying ice. When the ice-wall becomes on the melting of the ice too weak for the pressure of the inclosed air, these holes break up with a peculiar crackling sound, which in summer is continually to be heard from the pieces of glacier ice floating about in the fjords.

Many other extremely interesting observations were made on this journey as to the nature of Arctic land-ice. For example Nordenskjöld says :—

"In many respects there is a very essential difference between the ice-field over which we now travelled and the inland ice-field in Greenland, which was visited by me in 1870. The reason of this may perhaps be in a great degree the fact that in North East Land we wandered over a kind of *nevé region*, that is to say, over a part of the glacier where the surface is occupied by a layer of snow which does not melt away during summer, while in Greenland at the beginning of the month of July the snow upon the surface of the glacier was on the contrary already nearly completely melted. No trace of the glacier lakes, the beautiful and abundant glacier streams, the fine waterfalls and fountains, &c., which occur everywhere on the Greenland inland ice, could be observed here, and the configuration of the surface showed that such forms never occur, or only to a very limited extent. The melting of the snow clearly goes on upon Spitzbergen on too inconsiderable a scale for such phenomena to arise." Another curious phenomenon of this Spitzbergen ice was an area near Cape Mohn which was intersected by canals which for the most part ran parallel with each other, at some places at a distance of only 300 feet. The depth was up to 40 feet, the breadth 30 to 100. "Sometimes, also, there occurred other depressions, bounded in all directions by precipitous sides, of greater depth than the glacier canals, but of limited extent; these, perhaps, may most fitly be called by the name given them by the sailors—*docks* or *glacier docks*." With regard to the cause of these curious phenomena Prof. Nordenskjöld writes :—

"The inland ice of North East Land was at the time of our visit too much covered with snow for me to make out with complete certainty the way in which the glacier *canals* originate. That they were not river channels was clear. For they were much deeper than the river channels on the Greenland inland ice, where, however, the melting of the snow must proceed on a much more considerable scale than on Spitzbergen, and they occur in too close proximity at certain places (while at others they are completely absent) for them to be the beds of the channels of the streams, certainly very inconsiderable, which are produced here during the height of summer. There is a strong probability, on the other hand, that they originate from faults in the ice, strongly resembling those that are observed in the solid strata of the earth, and which, there as here, derive their origin from the alternate expansion and contraction of the strata or the ice in consequence of variations of temperature."

While Nordenskjöld was out on this sledge journey the work at Mussel Bay was still carried on. Soon after Nordenskjöld's departure Wÿkander commenced a series of pendulum observations. The tidal observations were also extended. Five minute observations were carried on at least a whole hour twice a day, at ebb and flood. After the long, dreary, and trying winter, our readers can easily imagine how welcome was the sight of Mr. Leigh Smith's yacht the *Diana*, steaming into the bay on June 12, with an abundant supply of much-needed comforts and luxuries.

From what we have written it will be seen that Mr. Leslie has been able to bring together from the wealth of material which exists on these various expeditions of Prof. Nordenskjöld, enough to render his volume one of general interest and great scientific value. We need not follow him in his narrative of Nordenskjöld's two journeys in 1875 and 1876 to the mouth of the Yenissei, for the purpose of proving that a sea-route from Europe along the north coast of Europe and Asia was perfectly practicable to that river. Some of the scientific results of these expeditions were published in NATURE at the time, and it is well known that so far as the immediate object was concerned the expeditions were completely successful. Full details will be found in Mr. Leslie's volume. From what we have said it will be seen that comparatively young as Prof. Nordenskjöld is, he has done an amount of work rarely accomplished even in a long lifetime. Appended to Mr. Leslie's volume is a long bibliography of the published results of these expeditions of Nordenskjöld, and from this it is evident that they have borne rich fruit in nearly every department of science.

HERING'S THEORY OF THE VISION OF LIGHT AND COLOURS[1]

II.

BEFORE propounding his theory, the author thinks it necessary to devote one memoir—the fourth—to an essay, the object of which is to define clearly the nature of the sensations of black and white and their mixture gray. He remarks that it is a habit to treat visual sensations rather according to their physical origin than by their own nature; and this peculiarly influences the ideas entertained about the sensations of black and white. We know that physically, white light is a combination of rays of all wave-lengths, and we have no physical notion of black except a negative one, namely, as an absence of light of any kind. Hence, transferring our physics to our physiology, we consider that our sensation of white is a positive one, but that our idea of black arises simply from the absence of all sensation; or, to use a metaphor drawn from painting, black is our canvas, or background, on which all our sensation-pictures are drawn in white or colours; as a result of this, all our reasoning is confined to the pictures, while the background receives no attention.

The author, as one of the main points of his theory, strongly objects to this view. He denies that the natural unimpressed state of the visual sensation corresponds with black, appealing to every-day experience in support of the opinion. Any one who carefully examines his impressions after being for some time in a perfectly dark room, will observe a dark field, it is true; but if he tries, in imagination, to compare this with his sensation of a piece of the blackest velvet, he will be obliged to admit that the field is nothing approaching the latter in darkness; it is, in fact, only dark gray. Or as an easier and simpler test, let him compare the black after-image of a white disk with the general field given by his closed and darkened eyes, and he will observe a similar contrast.

The author's view is that the impression of black, like that of white, can only be derived from external sources; and that consequently black is a perfectly independent visual sensation, which should be studied physiologically like those of white, or red, or blue. On physiological grounds it is no more reasonable to consider black as the absence of white, than white as the absence of black, or blue as the absence of yellow, or to consider a sphere as the absence of solids of every other form.

On this principle he proceeds to discuss the sensation of gray. He objects to the usual mode of defining different shades of gray as merely different *intensities of light*. He considers any sensation of gray as a combination of the two independent sensations, black and white, in certain proportions; he calls this accordingly a *black-white* sensation, and he proposes to express it in a mathematical form. The full and perfect extreme sensations are practically unknown, and therefore no positive quantitative expressions can be used for them. But it is quite permissible to give an algebraical idea of the difference between intermediate gradations, and this may be done in the form of a ratio, or fraction, of which the two components express the assumed amounts of white and black respectively that are combined in the sensation. For example, there must be a practical gray (though we cannot identify its exact shade) which is intermediate between white and black, resulting from an equal force of each sensation. Here therefore if W = the force of the white sensation, and B = that of the black one, $\frac{W}{B} = \frac{1}{1}$ or $= 1$. For a lighter gray in which there is twice as much white as black, $\frac{W}{B} = \frac{2}{1} = 2$. And for a darker gray, in which there is twice as much black as white, $\frac{W}{B} = \frac{1}{2}$. On this principle the pure white sensation would be expressed by $\frac{W}{0} = \infty$, and the pure black sensation by $\frac{0}{B} = 0$.

It is possible, still retaining the principle, to give a more convenient expression for the brightness or lightness (*Helligkeit*) of any black-white sensation; thus, the degree of brightness may be expressed by the ratio which the *white element* bears to the *whole sensation*, or $= \frac{W}{W+B}$. Thus the brightness of the medium gray will be $= \frac{1}{1+1} = \frac{1}{2} = 0{\cdot}5$; and that of the mixture of two white to one black will be $= \frac{2}{2+1} = \frac{2}{3} = 0{\cdot}66$; and that of the mixture of two black to one white $= \frac{1}{1+2} = \frac{1}{3} = 0{\cdot}33$. The brightness of pure white will be $= \frac{1}{1+0} = 1$, and that of pure black $= \frac{0}{0+1} = 0$. This mode of definition corresponds to the usual practical idea of the *intensity* of white in gray, but it differs from it by acknowledging the independent black element in the composition.

In the fifth memoir we at length get a statement of the fundamental features of the author's theory, so far as the black-white sensation is concerned.

He begins by objecting to the treatment of white as a mixture of complementary colours, as blue and yellow, or red and green, or of all colours together, an idea which has arisen solely from physical considerations. No one, he says, can pretend that the least trace of any other colour can be distinguished in a pure white sensation; all that can be said is that the sensation of white is produced by a mixture of light of different wave-lengths. But the sensation is a perfectly independent one, like black, or red, and must be so considered in an investigation into the *rationale* of the visual perceptions.

Since the physiologist considers all sensations as called into existence by physical processes of the nervous system (for otherwise every physiological investigation would be objectless), he must assume so-called psycho-physical processes or movements which correspond to the sensations of black, of white, and of all shades between them. In what part of the nervous system these psycho-physical processes are situated it is impossible to say; suffice it that, somewhere in the nervous apparatus of the eye and the parts of the brain standing in functional relation therewith, a substance must be sought, with the changes or motion of which the sensation is bound up; this substance may be called the "visual substance" (*Sehsubstanz*).

The action of this substance may be studied in two ways: either *à priori*, by considering the physical influences brought to bear upon it, or, *à posteriori*, by considering the sensations resulting from its changes. The former mode has hitherto been of little profit, for

[1] Continued from p. 613.

although we can follow the ether vibrations to the retina, it has not been possible to trace what happens beyond. We can, indeed, compare the physical influences with the sensations produced, but we are obliged, in doing so, to skip over the intervening physiological steps where the chief interest lies. Hence the backward study of the processes, as inferred from their results, affords the best chance of success.

As to the general nature of the action of the visual substance, we have a choice between the idea of mechanical vibrations and that of chemical changes. Modern physiology points to the latter, for the general physiology of the nerves has sufficiently shown that all movement and all activity of the nervous substance produces chemical changes in it, and all our representations of changes of sensitiveness, fatigue, and restoration after activity, are founded on the assumption of such chemical changes. And however varied may be the views as to the details of this action, so far is certain that the continual presence of chemical processes in every vital and sensitive substance is a fact, and that material change is the most universal known property of every living thing.

It is therefore taken for granted that light produces chemical changes in the nervous apparatus of the visual organs; and what we term fatigue and change of sensitiveness depend, by general consent, on chemical changes of the sensitive substance. Hitherto, however, it has been customary only to consider this (so far as black and white are concerned) as an effect of *white* light; the element of black being neglected altogether, as already explained. The author proposes to correct this error, and he formulates his extended theory as follows:—

The two kinds of sensation which we call white (*or light*) *and black* (*or aark*) *correspond to two distinct kinds of chemical action in the visual substance;* and the various proportions in which these appear in the mixed sensation of gray, correspond to the same proportions of intensity of these two psycho-physical processes.

This is the simplest explanation conceivable, and it fulfils every condition demanded by general nervous physiology. We must assume a sensitive substance in the visual apparatus, which suffers a change by the action of light, and this change is generally believed to be a chemical one; and when the stimulating action is removed there must be a corresponding change in the other direction, giving a return to the normal condition. If the former change is assumed to be a partial consumption of matter, then the opposite change must be a restitution; if the former change is an analytical or disintegrating one, the latter must be a synthetical or reintegrating one, and so on.

Now the latter process, by which the living organic substance replaces the quantity lost by stimulation or activity, is usually called *assimilation*, and the author retains this name. The previous or contrary process, where the loss is caused by stimulation or activity, he calls *dissimilation*. Having to use these terms very often he denotes them by the letters A and D respectively.

These two processes result from the knowledge of physiology in general, and if they are correct, there is no reason why, as heretofore, only one of them, D, should be admitted to a theory of visual perception, and the other, A, excluded from it. The author's theory of the black-white sensation, therefore, embodies the proposition that *the sensation of white corresponds to dissimilation, and that of black to assimilation of the visual substance*, so that our visual sensations furnish a psychical expression of the correlation of the changes in the matter of this substance.

The following propositions are easily deducible from this principle.

The degree of lightness or darkness of a colourless visual sensation corresponds with the proportion between the intensities or magnitudes of the D and A actions respectively. For the medium gray these actions are equal, $\left(\frac{D}{A} = \frac{W}{B} = 1\right)$, so that the state of the visual substance remains constant. For a lighter gray D is greater than A, while for a darker gray the reverse is the case.

If we call all stimulating actions which favour dissimilation, D stimuli, and if we borrow from general physiology the proposition that the magnitude of the reaction with which an organ answers to its stimulus depends also on the mass of the excitable substance it offers to be acted on, we get the principle that the *magnitude of the dissimilation caused by a* D-*stimulus depends not only on the force of this stimulus, but also on the quantity of the excitable substance present.*

But the ability of an excitable substance to be set by a stimulus, in a state of excitation, is called its excitability (*Erregbarkeit*), and the previous proposition may be thus expressed:—

Every increase of the excitable substance necessitates a raising, every decrease a lowering, of the D-*excitability of the visual organ.* Hence the sensation of medium gray implies a uniformity, every brighter sensation a decrease, and every darker sensation an increase of the D-excitability. And it follows that if, at the same time, images of different brightness fall on two places of equal D-excitability, the place of the brighter sensation will have its excitability lowered, and *vice versa.*

The author further explains the law, that in any compound sensation, the prominence of any particular single one is expressed by the ratio which the magnitude or "weight" of that sensation bears to the sum of all the sensations present. For example, in a gray, the prominence of white $= \frac{W}{W + B}$. If the sensation of yellow is also present in an amount = Y, it will be $= \frac{W}{W + B + Y}$, and the prominence of yellow will be $= \frac{Y}{W + B + Y}$.

These being the chief features of the author's theory he goes on to show how it is applied to explain the various phenomena already mentioned, particularly those of subjective vision.

The first point necessary to be explained is what may be called the normal state of the visual organs, *i.e.*, the sensation experienced when the eyes have long been closed and darkened, as on awaking in a perfectly dark room. It has already been explained that this sensation, although dark, is far removed from what we know as black. It follows from the theory that in this state the D and the A actions should be in equilibrium, *i.e.*, about equally great or $\frac{D}{A} = 1$, according to which the sensation should correspond to the medium gray.

The author remarks on the fact that, comparing the actual sensation with the brightest sun-light on the one hand and the blackest known velvet on the other, it would seem to be far nearer the black than the white; but we have no reason to believe that the darkest sensation we can get at all approaches absolute blackness. He thinks it possible that if we could get rays as near the black end of the scale as sun-light is near the white end, we should find their effect as powerful. But such rays do not exist in nature, and in our ignorance of them we cannot define accurately what may or may not be the true medium gray.

Next is given an explanation of *Simultaneous Contrast.* The before-mentioned experiments have shown that when one part of the visual organ is stimulated by light, the effect is to darken the sensation in the parts around. The theory admits of the explanation of this in several ways; but the author prefers the following:—In a partial stimulus by light a reaction is set up not only by the parts directly stimulated, but by the surrounding parts; the former through increased dissimilation, the latter through increased assimilation, which, however, is most powerful close to the lighted part, and diminishes fast with the distance from it.

This explains why, in a lighted room, the parts in shade appear black, much darker than our sensation with closed eyes, although the D-stimulus is equally active in both cases; and not only do the so-called dark parts really reflect some light, but a portion of dispersed light by objective irradiation enters the eye, which latter is strongest in the immediate neighbourhood of the bright object. But the increase of the assimilation prevents the perception of this light, and thus the ground is darkened, and the boundaries of the bright object are more sharply defined and brought out.

It is a result of this theory, that when two neighbouring parts of the retina are both stimulated by light at the same time, each reacts on the other by increased assimilation, the effect of which is to reduce the brightness of both. Hence, a small white surface is brighter than a large one of the same objective material. This may be easily seen by putting a large sheet of white paper, and a small strip of the same, both on a black ground. Or hold against the sky a large sheet of black paper, near the edge of which a small hole has been pierced; the point of light thus produced will be far more intense than that perceived round the edge of the paper. This is also the explanation of the great apparent brilliancy of the stars, the objective illumination of which is so very weak.

Explanation of *Simultaneous and Successive Light Induction.* Following up the process above described for simultaneous contrast, suppose the white object on the black ground to be further steadfastly observed for a longer time. The increase of assimilation in the parts immediately surrounding the white will cause an increase of the excitable substance, and will thus bring about an increase of excitability there. Hence the constantly working inner stimulus and the weak dispersed light of the black ground will acquire more dissimilating effect, while the assimilation gradually becomes weaker. Hence will follow an increase of apparent brightness on the parts previously darkened by contrast; this is *simultaneous light induction.* At the same time that the ground brightens in this way, the part of the visual organ impressed by the white surface suffers, by the prolonged dissimilation, a diminution of the excitable substance, whereby the excitability diminishes and the apparent brightness consequently diminishes also. If the contrast be made with only a slight difference in shade, and if the observation be carried on long enough, a phase will ultimately set in, in which by the gradual brightening of the ground and darkening of the whiter surface, they will both acquire the same appearance, and the distinction between them will disappear. This may be easily proved by experiment, but to prevent the confusing effect of the outlines, it is better shown by making, on white paper, dark patterns with shaded edges, when the effect will be soon apparent.

As the illumination of the light surface decreases it loses its power to favour the assimilation in the neighbouring dark parts, while the dissimilation under the influence of the inner D-stimulus not only goes on, but finds a greatly increased excitability to work upon; *i.e.*, according to the theory, the proportion $\frac{D}{A}\left(\frac{W}{S}\right)$ becomes greater, which means that the sensation increases in brightness. Hence, after sufficiently long steadfast observation, the bright-light space appears, and when the eyes are shut the sensation remains, as before described, giving *successive light induction.*

The explanation of *Successive Contrast* is given in four illustrations:—1. Observe fixedly a white stripe left between two large black surfaces; it will be seen that the original brightness gradually diminishes, and if the black surfaces be suddenly removed so as to leave an entirely white ground, the stripe will appear upon it as an after-image of a dark gray. This is, acccording to the theory, the result of the sudden bright illumination of the neighbouring parts; before this took place the dissimilation was powerful on the stripe, and (as before explained) excited an assimilation on the neighbouring black parts; this increased the D-excitability, and when the black surfaces were removed the white suddenly began to act with great power, setting up an assimilating action on the stripe where the excitability had been just before diminished, and so resulted the darkening effect on the latter.

2. Observe a small black stripe between two large sheets of white paper; it will at first appear very dark, but will gradually become lighter, and if the white sheets be suddenly removed, it will appear light on the black ground. This is the ordinary simultaneous and successive light induction already explained.

3. Lay a narrow white stripe on a black ground, observe it for a time, and then suddenly remove it; the place where it was will then appear blacker, and its neighbourhood lighter, than before. While observing the white stripe, the excitability upon it was diminished, and that around it increased, on the principles already explained: and on its removal the neighbouring parts were more impressed, and the place of the stripe less so, by the inner stimulus and the faint light of the general black ground.

4. Observe a black stripe on a white ground, and then suddenly remove it, leaving the whole field white. The place of the stripe will appear a brighter white surrounded by a darker space of a gray tinge. This is simply the converse of No. 3. The excitability was raised on the stripe and lowered around it; and when the whole field became active as a stimulus, the sensation was more powerful in the former place than the latter.

Lastly, the author devotes a chapter to the consideration of the *fatigue* of the visual organ. He says this may arise from two causes. When a light-stimulus is received, both a D-action and an A-action are set up, as previously explained: the D-action will naturally fatigue the organ by the dissimilation of the visual substance, but a similar result may follow also from the A-action if the assimilation goes on at a greater rate than fresh matter can be provided by the blood-supply. After looking at any very bright object, as the sun, and then covering the eyes, the after-image is not at first negative, but positive, and this bright impression may last for a long time, although, if the vision be thrown on white paper, the image will appear darker.

The explanation is as follows:—While looking at the bright object there is set up not only a strong dissimilation, but also a very considerable though less strong, assimilation. By the first the D-excitability will be greatly diminished, and by the latter the material in store will be quickly used up. Hence in the darkened eye, the sensation caused by the inner D-stimulus will be opposed only by a very weak A-action, so giving an after-impression of light, but of no great power. As the blood affords fresh matter, the equilibrium will be restored, and the appearance will die away.

In making the experiments hereinbefore mentioned on subjective vision, many different phases set in; these, though generally attributed to chance, are really due, in a large measure to the complicated influences of fatigue, caused as above described, and to their interference with the regular course of the light-induction and other processes hereinbefore described.

The author states, in conclusion, that he is far from believing that the theory he has developed is perfect, or incapable of correction, but he considers it comes nearer the truth than any other. WILLIAM POLE

(To be continued.)

NOTES

THE following botanical appointments have been recently made by the Colonial Office, on the recommendation of the Director of the Royal Gardens, Kew:—H. Trimen, M.B. Lond., F.L.S., Senior Assistant in the Department of Botany, British Museum, to be Director of the Royal Botanic Garden, Ceylon, in the place of Dr. Thwaites, C.M.G., F.R.S., who retires on pension with the title of Honorary Government Botanist. D. Morris, B.A., Trin. Coll. Dubl., F.G.S., late Assistant-Director of the Royal Botanic Garden, Ceylon, to be Director of the Botanical Department, Jamaica. H. Marshall Ward, scholar of Christ's College, Cambridge, to be employed for two years as Cryptogamist in the investigation of the coffee-leaf disease in Ceylon. He will be subordinated to the Director of the Botanic Garden, and will have the use of the Assistant-Director's house. Mr. Morris and Mr. Ward were formerly students of the Science and Art Department.

OUR readers will deeply sympathise with Sir John Lubbock under the heavy affliction with which he has been visited by the death of Lady Lubbock, which took place on the 20th instant. Her natural abilities were of no mean order, and the warm interest she took in all her husband's pursuits must have afforded him at once encouragement and aid in many of his undertakings. Her sympathies also extended to her husband's friends, and not a few of our readers will be able to call to mind the kind and hospitable reception which they have met with at her hands. Though for some years not in robust health, it was not, we believe, until within the last few weeks that any serious apprehension was entertained of the result of her illness. Lady Lubbock contributed a paper on the Shell-Mounds of Denmark to the volume of "Vacation Journals" for 1862-63; from time to time she was a contributor to NATURE, and some few of her writings have appeared in a published form elsewhere; these, however, would afford but a poor criterion of all that she has directly and indirectly done towards the advancement of natural science.

IT is with extreme regret that we record the death, after a long and painful illness, of Charles Henry Jeens, the well-known line engraver. Most of our readers are acquainted with the beautiful portraits of "Scientific Worthies" that appear from time to time in NATURE, and many of them can doubtless testify from personal knowledge to the truth and accuracy of these portraits. Few artists ever possessed so fully as Mr. Jeens that esoteric faculty—which so many lack—for realising in an engraving the salient and best expression of a face and of making a portrait really characteristic and life-like. This faculty he held to the last, and increasing illness and pain only seemed to sharpen it. Apart from their value as excellent likenesses these portraits are of high artistic value. Mr. Jeens was noted for the firmness and delicacy of his work, and nowhere are these qualities better shown than in his small portraits. We are glad to say that before he died he had completed several fresh engravings for the series of "Scientific Worthies," which will be issued in due course and possess a mournful interest of their own. Mr. Jeens was only fifty-two years of age when he died.

MR. C. P. EDISON, nephew of the great American inventor, has just died at Paris at the early age of twenty-four. He was his uncle's principal assistant in the production of the loud-speaking telephone, and was sent over to London by him to exhibit that instrument before the Prince of Wales, the Royal Society, &c. He had of late been engaged in applying his uncle's system of quadruplex telegraphy between Paris and Brussels.

AT the annual general meeting of the Cambridge Philosophical Society on Monday evening last, Prof. Alfred Newton, F.R.S., was elected President in the place of Prof. Liveing, who has served two years. The Vice-Presidents, in addition to the retiring President, are Prof. Stokes and Dr. Michael Foster. The Secretaries remain as before. New Members of the Council: Dr. Phear (Master of Emmanuel College), Prof. Hughes (Woodwardian Professor), and Mr. W. D. Niven, of Trinity College. Prof. Cayley and Mr. W. M. Hicks, of St. John's College, read papers, the latter on the Problem of Two Pulsating Spheres in a Fluid. Prof. Newton, in assuming the Presidency, said he felt bound to put aside all his feelings against holding this responsible position, in view of the wishes of the Council, and also considering that his election was to be regarded not only as a personal compliment, but as a tribute to those studies of which, by virtue of his position, he might be held to be representative. The next meeting of the Society is on November 10, and the junior secretary, Mr. Glaisher, is authorised to receive all communications relating to papers to be read before the Society.

THE sixth meeting of Russian naturalists will be opened at St. Petersburg on January 1. The Committee is composed of professors of the St. Petersburg University, Beketoff, Petrushevsky, Ovsiannikoff, Tamintzin, Wagner, Menshutkov, and Snostrantseff. The meeting will last for ten days, and will have eight sections: Anatomy and Physiology; Zoology and Comparative Anatomy; Botany; Mineralogy, Geology, and Palæontology; Chemistry and Physics; Astronomy and Mathematics; Anthropology; and Scientific Medicine.

THE last verification of the axes of the Gothard tunnel between Airolo and Göschenen was to be made this week. It is now confidently expected that the workmen from the two extremities of the tunnel will shake hands midway in the mountain before New Year's Day.

PROF. A. H. SAYCE appeals to the public through the *Times* on behalf of a tour of exploration in Biblical lands, in which Mr. W. St. Chad Boscawen, the well-known Assyrian scholar, is at present engaged. Through the kindness of a few friends funds have been raised to carry him as far as Beyrout, whence he hopes to travel through Northern Syria and the Tigro-Euphrates Valley, visiting and examining on his way the sites of Carchemish and other Hittite cities, Nineveh, Calah, Assur (the ancient Assyrian capital), Balawat (from which Mr. Rassam obtained the bronze gates now in the British Museum), and Bagdad. Bagdad will be a centre for exploring Ur. The success of the expedition will, of course, largely depend on the funds at Mr. Boscawen's disposal, and Mr. Sayce hopes, therefore, that he will be assisted in his work by those interested in the archæology of the East. Subscription will be received by the treasurer of the fund, Mr. Edmond Beales, Osborn House, Bolton Gardens South, South Kensington.

ON Saturday, October 25, the five academies constituting the Institute of France had a solemn meeting to award the biennial prize granted every two years by one of the academies. The turn this year being that of the Academy of Moral and Political Sciences, the prize was taken by M. Demolombe, dean of the Faculté de Droit of Caen, author of a voluminous work on legislation. The meeting was presided over by M. Daubrée, actual president of the Academy of Sciences, who delivered a very short inaugural address; but the learned geologist did not omit to make allusion to the unity of composition of the whole solar system as testified by the analysis of aërolites.

DURING the last few weeks the workmen engaged in making a road near Colberg, in Pomerania, found several indications that they were in the neighbourhood of an ancient burial place. The proprietor of the site, Herr von Kamecke, being solicitous for the preservation of any remains which might be found, had some excavations made under proper control. Twenty urns were found; most of them had been shattered by the penetration of roots of trees and other causes, so that some of their contents only could be rescued. However, three large and two smaller urns were saved, quite uninjured, and two other large ones were taken up much shattered. The contents of the urns consisted chiefly of a sort of glass beads, rings, and needles of bronze and some small fragments of bronze wire. One iron needle and two iron rings were also found. All the things saved have been handed over to the Pomeranian Historical and Antiquarian Society.

SEVERAL German newspapers strongly deprecate the undignified tone which seems to have reigned amongst the participators in the recent celebration at Pompeii. It appears that the majority of the visitors treated the whole matter as an excellent joke, and behaved very much as they would have done at a fair or at some other Neapolitan *fête*. Many of the archæologists who had come long distances to be present at the celebration, left the dead city in disgust at the behaviour of the multitude, long before the proceedings were half over. One of the articles referred to expresses the hope that in the year 1979 the Neapolitans will have sufficiently improved in manners as well as gained in seriousness, to render a repetition of the disgraceful scene impossible.

THE London correspondent of the *Scotsman*, who is usually particularly well informed, states the Treasury has definitely decided not to ask Parliament for the cost of fitting up the new Natural History Museum at South Kensington and for the removal of the Natural History Department of the British Museum thereto till 1881. We are glad to be assured, however, that this statement should only be received as a rumour, and is not yet sufficiently authenticated. Let us trust that it will not be authenticated at all.

WE have received vol. iv. of the *Entomologische Nachrichten*, edited by Dr. F. Katter, Gymnasiallehrer am k. Pädogogium zu Putbus, Insel Rügen (Quedlinburg: Vieweg). We believe this magazine was started a few years ago as a monthly publication; but it is now issued fortnightly. It supplies a want that doubtless was long felt amongst German entomologists, affording a medium for constant intercommunication, and containing, moreover, many biological and other notes of much more than ephemeral value, notices of interesting excursions, discussions on the best means of preparing insects for scientific study, some good notices of new books, useful general bibliographic information, &c. We imagine most working entomologists in this country who can read German already see it, those who do not will find it to their advantage to possess it.

THE death is announced of Dr. Eugen Dühring, the well-known author of the "Kritische Geschichte der allgemeinen Principien der Mechanik" and "Privatdocent" in Berlin. He was born in 1833 in Berlin.

THE Committee appointed by the Royal Irish Academy to investigate the rocks of the districts of the Curlew Mountains and about Fintona, have discovered in the supposed "Old Red Sandstone" fossils of Silurian types.

THE thirteenth session of the Whitehaven Scientific Association was opened on the evening of Tuesday, October 21, when a *conversazione* was held in the Town Hall, which was largely attended by the members of the Association and their friends. The president for the year, Mr. A. Kitchin, F.C.S., delivered an address eulogistic of the labours of Dalton, with reference specially to the atomic theory. Crookes's tubes illustrating the properties of "radiant matter" were exhibited, and many objects of interest in science and art were also displayed in the room. The Association, which now numbers nearly 300 members, has been of considerable benefit in popularising science, mainly in the direction of series of lectures. It has formed the nucleus of a museum intended to represent local natural history, and has also established a library of scientific works. It is to be regretted that classes, in connection with the Association, have not hitherto been successful; further efforts in this direction are desirable in order that the work of the society may have the permanent value which systematic teaching alone can give.

A LOCAL anthropological exhibition is to be opened at Kazan by the local society of naturalists. We wish success to this young society, which displays a remarkable activity, and the publications of which contain many most valuable scientific papers.

IN consequence of the great efforts recently made for the improvement of the several Electrical specialties, a Chambre Syndicale of Electricity has been established in Paris. The number of subscribers is seventy-five, and the first meeting took place on October 27.

M. BROCA has presented to the Anthropological Society of Paris the head of Ataï, the principal mover of the great Kanaki rebellion in New Caledonia, and of a native enchanter who was killed in the same battle as the chief. These two heads had been cut off by a soldier, preserved in spirit and brought to Paris by him as a curiosity. They will be submitted to a thorough scientific examination.

FOR the first time perhaps in the history of electric lighting two rival magneto-electric machines are illuminating the same hall. The Lontin and Siemens generators and lights are exhibited at about 120 yards from each other in the large hall of the Palais de l'Industrie, at Paris. Each electrical machine is worked by steam, and consumes a certain amount of horse-power. The competition is too recent to offer yet any definite opinion on the respective merits of the apparatus confronting each other.

TELEGRAMS from Murcia state that the city and celebrated *Muerta* were inundated by an immense waterspout which was formed in the sea at a distance from the coast on the night of October 14–15. Salt water was discovered at a distance of 45 kilometres from the sea. Another great atmospherical commotion was experienced three days afterwards. A night snowstorm enveloped the whole of Austria and Switzerland, and in Vienna the thickness of the snowfall was several inches. It is the first time since 1852 that snow has fallen so early in Vienna, but not the earliest time on record, as in 1769 it fell on October 12.

A CEYLON paper states than an illustrated work on the Lepidoptera of the island is to be published at the expense of the Colonial Government.

RECENT intelligence from Victoria states that coal has been found on the Murray River near its confluence with the Murrumbidgee.

THE Phylloxera has appeared in the district of Geelong, Victoria.

A BRILLIANT meteor was observed at 5 P.M. on the 13th at Belluno, Italy. It was first bright red and then greenish white, and moved from east to west, at an angle of 45 deg. with the horizon.

THE Société française de Physique commences its meetings for the approaching session of 1879–80 on November 7.

WE would call attention to a very useful Index which has been begun in the *Gardeners' Chronicle* of October 11. It is intended to comprise references to the *more important* plants mentioned in the *Chronicle* from 1841 to 1878, including numerous original descriptions by Lindley, Hooker, De Candolle, &c. This Index we think is likely to prove useful to botanists at large, and especially to those who are interested in the history of cultivated plants, and who may wish to know where to lay their hands on figures or descriptions of them.

THE applications of science at least seem to be obtaining some attention at the Antipodes; Stillwell and Co., of Melbourne, send us the following announcement of a new work to be published by them: "The Chemistry of Agriculture," by R. W. Emerson MacIvor, A.I.C., F.C.S., &c., lately Senior Demonstrator of Theoretical and Practical Chemistry, Anderson's University, Glasgow, with Appendices: Victorian Geology in its Relation to Agriculture, by Norman Taylor (of the late Geological Survey). The Conservation of Water for Agricultural and Pastoral Purposes, by G. Gordon, M.I.C.E. Suggestions on the Maintenance, Creation, and Enrichment of Forests, &c., by Baron von Mueller, K.C.M.G., F.R.S., &c.

THE Astro-physical Observatory on the Telegraphenberg, near Potsdam, was completed during September last, and has now been definitely handed over to its scientific directors.

PROF. SILVANUS THOMPSON has published a pamphlet of 74 pp. on apprenticeship schools in France, a subject on which he read a paper at the recent meeting of the British Association. The little book deserves the attention of all interested in technical education.

THE West London Scientific Association issue a very satisfactory Report for 1878–9.

THE museum of the St. Petersburg Academy of Sciences has made a valuable acquisition in the head of a *Rhinoceros tichorhinus*, very well preserved and covered with patches of hair. It is a part of a nearly complete carcass which was discovered on the banks of a tributary of the Yana, some 130 miles north of Verkhoyanak.

MESSRS. CASSELL have sent us the first two parts of a work on "European Ferns," illustrated by beautifully coloured plates. The text is by Mr. James Britten.

WE notice a useful publication undertaken by the Kieff Society of Naturalists, being a complete index of all works on mathematics, natural science, and medicine that have appeared in Russia during the years 1872 to 1877. The index for these five years has already appeared.

ANOTHER useful private undertaking is a weekly paper, *Rossiyskaya Bibliografia* (Russian and Slave Bibliography), appearing at St. Petersburg; it contains the titles of all Russian and Polish publications, with short notices about some of them.

MESSRS. GRIFFITH AND FARRAN will shortly publish a book entitled "On the Leads; or, What the Planets Saw." The object of the work is to bring the planets of our system into nearer acquaintance, making each give an account of itself to a little girl who watches them through her father's telescope on the leads of the house; their mythological character being made the mouthpiece of their astronomical and physical history. It is written and illustrated by Mrs. A. A. Strange Butson.

THE additions to the Zoological Society's Gardens during the past week include two Bonnet Monkeys (*Macacus radiatus*) from India, presented respectively by Mr. S. E. Phillips and Mr. J. E. Medley; a Macaque Monkey (*Macacus cynomolgus*) from India, presented by Mrs. Franklin; a Lesser Black-backed Gull (*Larus fuscus*), British, presented by the Rev. F. H. Addams; a Mississippi Alligator (*Alligator mississippiensis*) from North America, presented by Capt. J. H. Mortimer; a Garnett's Galago (*Galago garnetti*) from East Africa, a Banded Ichneumon (*Herpestes fasciatus*) from West Africa, a Sœmmerring's Antelope (*Gazella sœmmerringi*) from Abyssinia, two Dufresne's Amazons (*Chrysotis dufresniana*) from South-East Brazil, purchased.

THE SANITARY CONGRESS

THIS Congress continued its meetings at Croydon during last week, when several interesting addresses were given. Mr. Douglas Galton, in his address last Thursday, spoke of that large class of conditions which are the direct result of the circumstances to which man is exposed in consequence of living in communities. All living beings are in a continual condition of change, which results in their throwing off from the body matters which poison earth, air, and water, unless space, time, and opportunity are afforded for the counteraction of these deleterious effects. He showed how thus resulted both epidemic and zymotic diseases, the presence or absence of which in any locality, and the degree of their virulence depend on the sanitary surroundings. Cholera and dysentery are principally connected with the condition of the water supply; while an epidemic prevails the question whether a given population shall suffer or escape may almost be predicted from a chemical analysis of the drinking water. It is to the physiologist and the chemist that we must look for the causes from which these baneful effects arise, and what are the conditions which should be altered to prevent or remove them. The engineer steps in after these causes have been pointed out, and it is for him to design the methods of prevention or removal.

In places where many dwellings are congregated together the requirements for health may be classed as—first, those that are common to the community, such as the supply of good water, the removal of foul water, and the removal of refuse matter; and secondly, those which immediately concern the individual householder, such as the condition of his house and the circumstances of its occupation. It is the interest of every person in a community that every other member of the community should live under conditions favourable to health. Each year, as the population increases and as dwellings multiply, so does the importance of promoting these conditions increase; and so long as preventible diseases exist throughout the country, we must not delude ourselves with the idea that we have done more than touch the borders of sanitary improvement. There are few subjects in which so many professions of progress have been made in the last few years as in the theoretical knowledge of how to provide a healthy dwelling and a healthy town. Books innumerable have been written upon the question. Physiologists have invented every conceivable theory; patentees have invented every conceivable description of apparatus; engineers, architects, and builders overwhelm you with professions of their knowledge of sanitary principles, and millions of money have been spent in furthering the schemes they have devised; and yet, in spite of all these efforts, there are few houses and very few towns where you would not easily detect some grievous sanitary blunders. Mr. Galton believes this to be due, in the first place, to the fact that the majority of men prefer anything to thinking for themselves. They like to obtain their knowledge as they do their hats—from a shop, ready-made. In the second place, the sanitary education of the country has not been brought into a system. In the third place, it has always seemed to Mr. Galton that the system under which the Government advances money for sanitary works, whilst of great *primâ facie* advantage in one point of view, yet has its disadvantageous aspect. Mr. Galton then entered into some detail as to the best system to be adopted for encouraging and carrying out sanitary works.

He thinks that we should have reached a higher level of sanitary improvement in this country than now prevails, if the Government had limited itself to its more legitimate functions, viz., first, the enactment of laws requiring sanitary defects to be removed; and second, the promotion of measures for diffusing a sound education in sanitary knowledge; instead of pursuing the course of endeavouring to dictate the exact measures to be followed in each case. But it may be asked, What is sanitary knowledge? It is frequently assumed that drainage and water-supply are the principal subjects which are embraced in the term; but these only make up a small part of the subject. At the present time there does not exist any treatise which brings to a focus the various problems of mechanical and physical science, upon which the knowledge is based.

Mr. Galton then gives several instances in connection with the construction of houses to illustrate the variety of the problems to be solved. A sanitarian tells us that health depends on pure air and pure water. If a site is to be selected, it requires a consideration of its position with respect to its surroundings. It requires a knowledge of the temperature of the air and of the soil; what are the prevailing winds; what is the amount and incidence of the rainfall; and what is the percolative capacity of the soil. The engineer cannot interfere with the general conditions of a climate, but he may produce important changes in the immediate surroundings of a locality: he may modify the condition and temperature of the soil; he may control atmospheric damp; he may arrange for the rapid removal of rainfall, or he may cause the rainfall to be retained in the soil, to be given out gradually in springs, instead of passing away in torrents to flood the neighbouring districts.

Mr. Galton showed by comparing the death-rate in the model lodging-houses in London with that of other districts that any extraordinary degree of unhealthiness in towns is unnecessary.

One important step in knowledge of sanitary construction is to learn how to obtain pure air in a building. What is pure air? What are the impurities which make the air of a town so different from the fresh air of the country? The volume of sulphuric acid from coal thrown up by our fires into London air is enormous. A cubic yard of London air has been found to contain nineteen grains of sulphurous acid. The street dust and mud is full of ammonia from horse-dung. The gases from the sewers pour into the town air. Our civilisation compels us to live in houses, and to maintain a temperature different from that out of doors. What are the conditions as to change under which we exist out of doors? Mr. Galton then proceeded to show that it is all but impossible to maintain a supply of pure air indoors. Any ventilating arrangements are only makeshifts to assist in remedying the evils to which we are exposed from the necessity of obtaining an atmosphere in our houses different in temperature from that of the outer air. On the other hand, means might be adopted to obtain as pure air as we can. Suspended matters exist in much smaller quantities at an altitude; at 100 feet they are greatly diminished; at 300 feet the air is comparatively pure. In Paris the air for the Legislative Assembly is drawn down from a height of 180 feet, so as to be taken from a point above many of the impurities of the town atmosphere. That is a reasonable and sensible arrangement, and might be usefully adopted in public buildings in towns. In the Houses of Parliament the so-called fresh air is taken from courtyards on the street level, from which horse traffic is not excluded. The maintenance of the standard of purity, or rather impurity, in a building, depends on ventilating arrangements. Ventilation chiefly depends on the laws which govern the movement of air, its dilatation by heat or contraction by cold; or, if ventilation is effected by pumps and fans, then upon the laws of the motion of air in channels, the friction they entail, and similar questions; therefore all these are matters for careful study. But when we apply the study to practice, other considerations occur. It may be summed up that, whatever the cubic space, the air in a confined space occupied by living beings may be assumed to attain a permanent degree of purity, or rather impurity, theoretically dependent upon the rate at which emanations are given out by the breathing and other exhalations of the occupants, and upon the rate at which fresh air is admitted, and that, therefore, the same supply of air will equally well ventilate any space, but the larger the cubic space the longer it will be before the air in it attains its permanent condition of impurity. Moreover, the larger the cubic space, the more easily will the supply of fresh air be brought in without altering the temperature, and without causing injurious draughts. "A room warmed by an open fire," Mr. Galton maintains, "is pleasanter than a room warmed by hot-water pipes. A warm body radiates heat to a colder body near to it. The heat rays from a flame or from incandescent matter pass through the air without heating it; they warm the solid bodies upon which they impinge, and these warm the air. Where the source of heat in a room consists of hot-water pipes, or low-pressure steam pipes, the air is first warmed, and imparts its heat to the walls. The air is thus warmer than the walls. When a room is warmed by an open fire, on the other hand, the warming is effected by the radiant heat from the fire, which passes through the air without sensibly warming it; the radiant heat warms the walls and furniture, and these impart their heat to the air. Therefore the walls in this case are warmer than the air. Consequently, in two rooms, one warmed by an open fire, and the other by hot-water pipes, and with air at the same temperature in both rooms, the walls in the room heated by hot-water pipes would be some degrees colder than the air in the room, and therefore colder than the walls of a room heated by an open fire; and these colder walls would therefore abstract heat from the occupants by radiation more rapidly than would be the case in the room heated by an open fire. And to bring the walls in the room heated with hot-water pipes to the same temperature as the walls in the rooms heated by the open fire would require the air of the room to be heated to an amount beyond that necessary for comfort, and therefore to a greater amount than is desirable. Besides theoretical knowledge, it is of essential importance that the sanitary architect, builder, or engineer, should have also practical technical knowledge of the subject. He should know what constitutes a good material and good workmanship. It is not only the officers of the army of sanitary constructors who require knowledge and education, but the foremen and the labourers, each in his own degree."

Prof. Corfield's address was on Sanitary Fallacies. After an interesting historical *résumé*, he dealt with some fallacies of the present day. Against all sanitary improvements whatever we find one argument continually brought—that things have gone on in the same way for many years, and there is no reason why they should be changed, that our forefathers from generation to generation lived under unsanitary conditions, and why should we not do the same? that cholera, or enteric fever, or diphtheria has never broken out in a place, or in a particular house, and so it need not be expected! Dr. Corfield showed how fallacious and mischievous this argument is. The arguments brought forward to support the spontaneous origination of the poisons of typhus and enteric fevers, of diphtheria, and of cholera, are most of them fallacious in the extreme, and the arguments advanced to prove the *de novo* origination of the poison of enteric fever, are of themselves sufficient to render it in the highest degree improbable. They are, indeed, so weak, that no one really capable of judging the value of a scientific argument, could from them come to any other conclusion than that the position was untenable. But a practical and very serious mischief has arisen from the spread of these doctrines. In the majority of cases no pains are taken to destroy the excremental discharges of patients suffering from such diseases, a neglect apt to lead to very dangerous consequences.

"But," Dr. Corfield went on to say, "there is still a great fallacy abroad in connection with the question of the removal of refuse matters from the vicinity of habitations. People talk and write as if the water-carriage system and the Conservancy systems stood upon the same footing—the principal of the one being the *immediate* removal of excretal matters from houses, and that of all the others being, as their name indicates, the keeping of such matters in and about the house for a certain time. The one is a correct principle, the other is a false one, and it is no argument at all to say that where the water-carriage system is badly carried out, the result may be worse than where the Conservancy system is carefully managed. In sanitary matters, as well as in everything else, we should follow correct principles. If we do not, but by arguments equally specious and fallacious, try to persuade ourselves that 'practically speaking' (according to the cant phraseology of the day) better results may be obtained by following false principles, nothing is more certain than that by an inexorable law of nature true principles will assert their position, and we shall be punished for our mistake by being landed in difficulties greater than we had to contend with at the outset. It is a very old and often-exposed fallacy to argue against the use of a thing from the abuse of it, and to argue against the water-carriage system because when surface drains have been called upon to do the duty of sewers, for which they were not intended, and of which they are not capable, or because the sewage has been turned into the water-courses, which have thus become unfit to supply water for domestic purposes, is an excellent example of this kind of fallacy."

Dr. Corfield went on to show that water containing the least quantity of organic matter must be regarded as dangerous, and that absolutely pure water should be insisted on, as the only safe form for sanitary purposes. With regard to dietetics, Dr. Corfield referred to the fallacies which existed for some time, as to the dietetic value of gelatine. He could not but think that it was a mistake to utterly condemn alcoholic liquors.

"There are those—" he said, "and I think there always will be—who cannot believe that the exquisite *bouquet* of the wines of France, of Italy, and of Spain is only fit to be smelt, there may even be those who are wicked enough to insinuate that if people do not taste them they show a lamentable deficiency in the cultivation of an important sense. He referred in conclusion to the anti-vaccination fallacy, and showed that statistics are dead against it.

Under the title of "Geology in Relation to Sanitary Science," Mr. Alfred Haviland gave some valuable hints as to what would be the practical difficulty in realising any of the dreams of a future proper state of society. He showed that even under the most favourable conditions of physique and surroundings population would so increase that migration would be an absolute necessity, the emigrants thus finding themselves in conditions totally different from those they left. They would stand face to face with the stern reality of change; a change so great they could not realize it. Help is called for; and science like a good genius, extends her hand. The dreamer and the dream are gone. Large as our world may be, it never has been, and we have no grounds for believing it ever will be, a universal paradise: and without it becomes so, the people of the dream can never become realities. We find not a single writing in the stones that records evidence of either uniform climate, uniform soil, or uniform conditions of any kind whatever conducing to the perfection of existence either among the lower or the higher classes of animals. The very factor so necessary to the perfection of type, viz., health, is the great factor of productiveness; and this productiveness is the factor of destruction by overcrowding. Over and over again has this been recorded on the rocks.

Man has not only spoiled many of the sites which his ancestors wisely selected as vantage grounds against the foe, the flood, and the drought; but is hourly spoiling his own form by his artificial habits, and laying at the same time the foundation for a still further departure from a natural standard in his offspring. He is polluting the soil on which his habitations stand, he is befouling his water-courses and springs, and he is poisoning the air he breathes. He has thus created surroundings from which he can with difficulty escape. "Now I hold," Mr. Haviland said, "that any institute established for the purpose of teaching us the science of living in a cleanly and wholesome manner—as regards water, air, and soil—should first of all teach in its schools what has already been taught by such men as I have mentioned, as a wholesome restraint against the pride which a little knowledge engenders. Before we can boast of any sanitary science, let us be able to point to our researches on the climates, the soils, the diseases we find at home and abroad in our vast colonies. Let the crust of the earth in various parts of the globe be thoroughly examined in its relation to diseases—recollecting that had not man been born, there are certain spots in this earth that produce certain specific poisons, the chemical constitution of which we know nothing. Such spots should be mapped, after having been thoroughly investigated as to soil and climate, for the use of emigrants, colonists, and those in command of our expensive but necessary soldiery."

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

CAMBRIDGE.—During Prof. Maxwell's illness, Mr. W. Garnett is lecturing for him at the Cavendish Laboratory, on Voltaic Electricity, Electro-magnetism, and Electric Measurements; the lectures are experimental. Mr. Garnett is also giving a more elementary experimental course of lectures on Mechanics and Hydrostatics, adapted to candidates for the First M.B. and First Part of the Natural Sciences Tripos. Prof. Stuart's workshop will be open for pupils this term at the New Museums. Practical instruction in the use of tools in wood or metal is provided, and further practical instruction for those who already have a sufficient knowledge of the use of the tools. During the present term his lectures will be on Mechanism. Mr. W. J. Lewis, M.A., Fellow of Oriel College, Oxford, has been incorporated as M.A. of Cambridge, and entered at Trinity College. Prof. W. H. Miller, F.R.S., Professor of Mineralogy, being in ill-health, Mr. W. J. Lewis has been appointed his deputy for twelve months, and Prof. Miller has assigned two-thirds of his whole annual stipend to his deputy. Mr. Lewis has for some time been working very assiduously in the Mineralogical Museum, and is now lecturing on Mineralogy, while in the Easter Term he intends to lecture on Crystallography and Crystallographic Physics. Next term Prof. Stuart's lectures will be on the Theory of Structures. Prof. Challis's lectures on Practical Astronomy are postponed on account of ill-health. Prof. Cayley will lecture this term on Differential Equations.

THE City and Guilds of London Institute for the Advancement of Technical Education, announce the opening of their technical classes, at Cowper Street School, Finsbury. In the section of applied physics, Mr. W. E. Ayrton will deliver a course of twelve lectures on "Some of the Practical Applications of Electricity and Magnetism," commencing on Monday, November 3, at 7 p.m. In that of applied chemistry, Dr. H. Armstrong, F.R.S., will deliver a similar course on "The First Principles of Chemistry," commencing Wednesday, November 5, at 8 p.m. An inaugural lecture will be delivered by Mr. Ayrton, on Saturday, November 1, at 8 p.m., on "The Improvement Science can Effect in our Trades, and in the Condition of our Workmen." A class in connection with this for the study of blowpipe analysis and assaying, will be commenced next week at the Birkbeck Institution, by Mr. G. Chaloner, F.C.S.

SOCIETIES AND ACADEMIES

PARIS

Academy of Sciences, October 20.—M. Daubrée in the chair.—The following papers were read:—Researches showing the power, the rapidity of action, and the varieties of certain inhibitory influences of the brain on itself or on the spinal cord, and of this latter centre on itself or on the brain, by M. Brown-Séquard.—Discovery of a small planet, by Mr. Peters (telegram from the Smithsonian Institution).—Observation of the planet 206, Peters, at the Paris Observatory, by MM. Henry.—Observations of declination, inclination, and horizontal intensity in the basin of the Mediterranean, by M. de Bernardière. These observations were made during a voyage of the training-ship, *La Flore*, in 1878-79. The numbers for some twenty-six places are tabulated.—On whole functions, by M. Picard.—On the Laurent saccharimeter, by M. Laurent. Two improved models were presented, giving more light and distinctness, while the reflections in the tubes are suppressed.—New researches on the mode of union of cells of the mucous bodies of Malpighi, by M. Ranvier. These cells, formed of masses of protoplasm with nuclei, are united by protoplasmic filaments, which are common to them and each of which does not result from junction of two filaments placed end to end, nor is the nodule occupying their middle the mark of a junction or juxtaposition; it is an elastic organ, which allows of easy enlargement of the spaces destined for circulation of nutritive juices between the cells.—On asphyxic glycæmia, by M. Dastre. Cl. Bernard affirmed that a prolonged asphyxic state destroyed the glycogen of the liver, and made the sugar disappear from the blood. Some physiologists hold, on the contrary, that in accordance with Lavoisier's theory, sugar accumulates in the blood when the oxygen (for its combustion) is diminished. M. Dastre considers we must distinguish between the effects of rapid asphyxia, immediately consequent on withdrawal of oxygen, and the consecutive effects of slow asphyxia (such as wasting of tissues and exhaustion of reserves). Rapid asphyxia may be realised in two ways, making an animal breathe air confined in a closed vessel, or making it breathe in rarefied air constantly renewed. He tried both on dogs, and found the quantity of sugar in the blood to vary in contrary direction to the quantity of oxygen (less oxygen, more sugar).

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