and a second or even third blow is therefore required to determine its explosion.

These circumstances would appear to afford support for the belief that the detonation of an explosive material through the agency of a blow is the result of the development of heat sufficient to establish energetic chemical change, by the expenditure of force in the compression of the material, or by the friction of the particles against each other, consequent upon a motion being momentarily imparted to them. It is conceivable that, from either of these causes, sufficient heat may be accumulated with almost instantaneous rapidity, in some portion of the mass struck, to develop sudden chemical change. The circumstance that the detonation of those portions of an explosive compound (such as gun-cotton or nitroglycerine) which are immediately between the surfaces of the hammer and the support is not communicated to the surrounding portions, may be ascribed to a combination of two causes, the instantaneous nature of the explosion, and the close confinement of the portions struck at the instance of their explosion. The mechanical effect of the detonation is absorbed by the masses of metal between which it occurred, and the gases developed disperse the surrounding portions of the explosive agent, as they rush away from between the two surfaces. It is possible also to detonate gunpowder and other explosive mixtures by a blow in such a manner that only the portions immediately struck are ignited; but those substances may also be exploded, though much less violently, by a less sudden or powerful application of force, in which case they detonate much more feebly; their explosion is accompanied by a larger volume of flame, and by the ignition of those portions which surround the part struck by the hammer. The power of accomplishing the explosion or detonation of gun-cotton or nitroglycerine in open air through the agency of a detonation produced in its vicinity, would therefore appear to be correctly ascribable to the heat suddenly developed in some portion of the mass by the mechanical effect, or blow, exerted by that detonation, and would seem to be regulated by the violence and suddenness (either singly or combined) of the detonation, by the extent to which the explosive material is in a condition to oppose resistance to the force, and by the degree of sensitiveness of the substance to explosion by percussion. There are, however, several well-known facts, and some results of experiments instituted with special reference to this subject, which do not appear to be in harmony with the assumption that the detonation of nitroglycerine and gun-cotton in the manner described is simply due to the *suddenness* of the development and application of physical force.

With the view of ascertaining whether the relative power of different explosive agents to accomplish the detonation of gun-cotton appears to be in direct proportion to the relative mechanical effects of their explosion (*i.e.* to the work performed by them upon a body placed in contact with them), a series of experiments was instituted with the object of comparing this particular action of the several explosive materials. It would appear from these experiments that, when unconfined, the violence of explosion of chloride of nitrogen is less than that of the iodide, and that, if confined under water, it very considerably exceeds that of the exposed iodide, but falls very short of that exerted by unconfined silver-fulminate. It also appears that the mercuric fulminate, which is much less rapidly explosive than either of the other substances, exerts less mechanical force than any of them, if freely open to air, and if inflamed at some portion of the exposed surfaces; if ignited at the lower inner portion of the mass, where the part first inflamed is enclosed by the mass of the material itself, it exerts a destructive force little inferior to that of the chloride of nitrogen enclosed by water; but if confined in a strong envelope (*e.g.* of sheet tin), the mercuric fulminate is greater in violence of action than the unconfined silver-fulminate. These results to a great extent confirm the correctness of the view that the readiness with which the detonation of gun-cotton is accomplished is in proportion to the mechanical force exerted by the initiative detonation to which it is subjected. The force exerted by small quantities of strongly confined silver and mercuric fulminate greatly exceeds that developed by the explosion of comparatively large proportions of the iodide and chloride of nitrogen. This may be accepted as accounting, to some extent, for the fact that the detonation of gun-cotton could not be accomplished by an amount of iodide of nitrogen twenty times greater than that of fulminates required for the purpose, while ten times the quantity of the confined chloride were required to produce the result. That the quantity of mercuric fulminate required to produce detonation is reduced in proportion as means are applied to increase the violence of the force exerted by it at one time, is quite in accordance with the above view.

I venture to offer the following as being the most satisfactory explanation which occurs to me of the remarkable differences exhibited in the behaviour of different explosive agents. The vibrations produced by a particular explosion, if synchronous with those which would result from the explosion of a neighbouring substance which is in a state of high chemical tension, will, by their tendency to develop those vibrations, either determine the explosion of that substance, or at any rate greatly aid the disturbing effect of mechanical force suddenly applied, while, in the case of another explosion which produces vibrations of different character, the mechanical force applied by its agency has to operate with little or no aid; greater force or a more powerful detonation must, therefore, be applied in the latter instance, if the explosion of the same substance is to be accomplished by it.

In conclusion, it may not be out of place to refer briefly to a few illustrations of the important bearings which the new mode of developing the explosive force of gun-cotton has upon the practical uses of the material as a destructive agent. The confinement of a charge of gun-powder or gun-cotton in a blast-hole, by firmly closing up the latter with earth, powdered rock, or other compressible material (by the process known as tamping or stemming) to a depth greater than the line of least resistance opposed to the action of the charge, is essential to the success of a blasting operation; but the great rapidity of explosion, by detonation, of a charge of gun-cotton greatly reduces the value of this operation; the destructive effect of the material, when exploded in a hole which is left open, is not inferior in extent to that obtained by similarly exploding a charge confined in the usual manner. Thus the most dangerous operation in connection with blasting may be entirely dispensed with. In submarine operations, it is no longer necessary to enclose the charge of explosive agent in the strong and therefore cumbersome metal receptacles hitherto required to ensure the full development of its explosive force; the destructive action of a charge of gun-cotton, enclosed in a waterproof bag or thin glass vessel and exploded by detonation, being decidedly greater than that furnished by a corresponding charge confined in a strong iron vessel and exploded by flame. Small charges of gun-cotton simply resting upon the upper surfaces, or loosely inserted into natural cavities, of very large masses of the hardest description of rock or of iron, have broken these up as effectually as if corresponding charges had been firmly imbedded in the centre of the mass and exploded in the usual manner. Lastly, the certainty, facility, and expedition with which certain important military destructive operations may be accomplished by means of gun-cotton exploded by detonation, are not among the least important advantages which are now secured to this interesting and remarkable explosive agent.

SCIENTIFIC SERIALS

POGGENDORFF'S *Annalen der Chemie und Pharmacie*, vol. cxl. part 1.—This number contains (1) the first part of an elaborate paper by E. Ketteler, "On the Influences of Ponderable Molecules on the Dispersion of Light, and on the Signification of the Constants in the Mathematical Formulæ for Dispersion" (pp. 1 to 53). This is a critical examination, based chiefly on Mascart's experimental measurements, of the formulæ by which Cauchy and others have endeavoured to connect the indices of refraction of the various kinds of light with their wave-lengths. The nature and scope of the investigation may be gathered from the four following criteria which the author gives as the tests of a satisfactory formula:—"1. A rational formula must enable us to calculate accurately from their wave-lengths the succession of the several colours and their distribution in space, for the whole measured extent of radiation, for some definite density of the dispersive medium. 2. The constants of the formula must be capable of a distinct physical interpretation, analogous to the interpretation assigned by Cristoffel to the constants in his formula. 3. When the density of the dispersive medium is altered, these constants must participate in the change of molecular constitution in some simple manner, corresponding to what has been ascertained in respect to them in the case of gaseous media. 4. Consequently, as the medium approaches the limit of rarefaction, all the indices must approach unity as their limiting value." The author finds that none of the formulæ hitherto proposed reproduce the experimental results within the limits of error of the measurements, but that this can be done by a formula which he proposes. (2.) "On the Sounds produced by Heated Tubes, and on the Vibrations of Air in Pipes of various Forms," by C. Sondhaus (pp. 53 to 76). Many experimenters must have observed the frequent production of a musical tone when a bulb has been blown at the end of a rather short and narrow glass tube, the sound beginning just as the tube with the still hot bulb is removed from the lips. This phenomenon formed the subject of an investigation by the author twenty years ago, and he now returns to it in a paper which is to be concluded in the next number of the *Annalen*. The principal result which he now publishes is that when the dimensions of bulb and tubes are properly proportioned, similar tones can be obtained with heated glass bulbs from which two open tubes proceed in opposite directions. He also gives an empirical formula which expresses approximately the pitch of the tones obtained in terms of the dimensions of the bulbs and tubes; but as this formula does not seem to be based on any physical explanation of the way in which the sounds are produced, and as it takes no account of temperature, the agreement between its results and those of observation must be considered as at least to some extent accidental. Perhaps the remainder of the paper may give further explanations on these points. (3.) "On Chromates," by C. Freese (pp. 76 to 88), to be concluded in the next part. (4.) "Thermo-chemical Investigations" (continued), by Julius Thomsen (pp. 88 to 114). This section of Professor Thomsen's researches relates to the acids of nitrogen, phosphorus, and arsenic. The thermo-chemical behaviour of these acids, when neutralised with caustic soda, appears to agree in the main with the commonly-received views of their basicity founded upon their chemical properties. (5.) "Further Researches into the Development of Electromotive Force between Liquids," by Jacob Worm-Müller (pp. 114 to 144). Among other results the author arrives at the following remarkable conclusion: "Solutions of acids and alkalis in equivalent proportions (that is such that equal volumes of the solutions neutralise each other) and of the salts formed by mixing equal volumes of these solutions, do not give rise to electric currents when connected so as to form a circuit." This paper also is to be concluded in the next number of the *Annalen*. (6.) "Researches in Electrical Dust-figures," by Wilhelm von Bezold (pp. 145 to 159). (7.) "On the Law of Formation of Kundt's Dust-figure," by Theodore Karrass (pp. 160 to 168). (8.) "On an Electrophorus-machine for Charging Batteries," by Peter Riess (pp. 168 to 172). The author describes a modification of Holtz's electrical machine, which renders it applicable for charging Leyden batteries to a high tension. (9.) "On the Measurement of the Absorption of Light by transparent media by means of the Spectroscope," by C. Vierordt (pp. 172 to 175). The author's method of measurement consists essentially in diminishing the intensity of each part of a normal spectrum, by means of smoked glasses of known absorptive power and the partial closing of the slit of the spectroscope, until it is identical with that of the light transmitted by the medium to be examined. (10.) "An Observation on the Induction-spark," by Dr. A. Weinhold (p. 176).

In the *Journal of Botany* for August, the original articles relate almost entirely to extra-English botany, with the exception of the conclusion of Mr. Worthington Smith's *Clavis Agaricinorum*, which forms an important contribution to the literature of cryptogamic botany.

In the *Proceedings of the Asiatic Society of Bengal* for June are three articles on the Andamanese, the most important of which is by Surgeon Francis Day. He estimates the number now living on the island as probably not much over 1,000, divided into several tribes, which have distinct dialects, so that members of the Little Andamans are scarcely able to understand those of the South Andamans. Their language is very deficient in words; many English and Hindustani words are now beginning to be incorporated in it; numerals are entirely absent. They are anything but prolific, and appear to be gradually dying out from excess of deaths over births. Mr. Day only saw one woman who had as many as three living children; during one year thirty-eight deaths were reported, and only fourteen births among the families living near the European settlements; few appear to live to a greater age than forty, and they are subject to a variety of diseases. We hope to return to this article again. Dr. G. von Martens contributes "Notes on some Javanese Algæ." The remaining articles in the number are philological.

SOCIETIES AND ACADEMIES

Paris

Academy of Sciences, August 8.—Papers were read on the relation between the specific heats and the coëfficients of dilatation of any body, by M. Phillips, and on the decimal division of the quadrant, by M. A. d'Abbadie, in which he communicated two letters on the subject from M. Nadau and Prof. Airy; and MM. Jamin and Richard contributed some observations on the determination of the relation between the two specific heats of gases.—M. Jamin replied to the two notes by M. Sainte-Claire Deville on July 18th, and entered again at length into the subject of the variations of temperature produced by the mixing of two liquids.—M. Laborde contributed a note on some new experiments on Holtz's electrical machine.—M. Elie de Beaumont presented, on behalf of M. Delesse, a lithological map of the embouchure of the Seine.—A note by MM. Rabuteau and Peyré was presented by M. Ch. Robin, on the poisonous effects of the m'boundou or icaja, a poison used at the Gaboon. The poison used was extracted chiefly from the bark, a small quantity also from the root. The experiments showed that the poison is extremely rapid; but that its fatal effects can be prevented by artificial respiration; the symptoms are in some respects similar to those produced by strychnine.—A letter was read from M. Lichtenstein to M. Dumas, on a means of preventing the irruption of the *Phylloxera vastatrix* in vines not yet attacked. The proposed plan is simply by destroying carefully, from May to August, all the branches on which the winged form of the insect has made its appearance.—A short note was also presented by M. L. Laliman, on a variety of vine (of the American species *V. æstivalis*) not subject to the attacks of the *Phylloxera*.

BOOKS RECEIVED

English.—Lectures on Art: J. Ruskin (New York: Wiley and Son).—The Laws of Verse: J. J. Sylvester (Longmans).—The Wind in his Circuits: R. H. Armit (J. D. Porter).—Matter for Materialists: T. Doubleday (Longmans).—The Book of the Roach; G. Fennell (Longmans).

Foreign.—(Through Williams and Norgate)—Etudes sur la maladie des vers à soie: L. Pasteur.—Streifzüge (landwirthschaftliche) in Frankreich u. Algerien im Jahre 1862-68: A Petzhold.—Leçons de Chimie, années 1868-69, Dehérain, &c.—Mineralogie der Vulcane: Dr. C. Landgrebe.—De l'enseignement supérieur en Angleterre et en Ecosse: J. Demoycot.—Zonula ciliaris: Dr. F. Merkel.—Deutsche Vierteljahrsschrift für öffentliche Gesundheitspflege: C. Reclam.—Prodromus Floræ Hispanicæ, Vols. 1 and 2: M. Willkom.—Algæ japonicæ Musæi botanici Lugduni-Batavi: W. F. R. Süringer.—Die Osteologie und Myologie von Sciurus vulgaris: C. K. Hoffman.

CONTENTS

Errata.—Page 296, first column, lines 10 and 11 from bottom, for "blosz Erscheinung" read "blose Erscheinung."—Page 308, first column, line 14, for "Phylloscera" read "Phylloxera."