THURSDAY, JUNE 26, 1902.

BIBLICAL CRITICISM AT ITS BEST AND WORST.

Encyclopaedia Biblica; a Critical Dictionary of the Literary, Political and Religious History, the Archaeology, Geography and Natural History of the Bible. Edited by the Rev. T. K. Cheyne, D.Litt., D.D., and J. Sutherland Black, M.A., LL.D. Vol. iii. (L to P). (London: Adam and Charles Black, 1902.)

WHEN the plan of the "Encyclopædia Biblica" was first announced several years ago, the most favourable anticipations were formed with regard to the new project by all advocates of a moderate and scientific criticism of the Biblical writings. This dictionary was to embody the ideal of the late Prof. Robertson Smith, an encyclopædia which should include within its purview the results of the latest criticism, provided only that this criticism was conceived in common sense, developed with moderation and expressed with that consideration for the holders of traditional views which in this case is absolutely required. The first volume of the "Encyclopædia" seemed entirely to fulfil these anticipations, and its appearance was welcome to all students of Biblical history and archæology; but in the second, various disquieting symptoms were noticeable, especially in Prof. Cheyne's article "Jerahme'el"; the third can only be frankly described as disappointing these initial hopes and as being, in fact, most damaging to the cause of the "higher criticism." Those who have a working knowledge of Biblical criticism will, of course, be able to discriminate between those parts of the "Encyclopædia" which are really useful and suggestive and those which are the reverse; but what of the vast majority of readers who do not know? It is probable that very many of these, wearied by Prof. Cheyne's incessant discussion of his "Jerahmeelites" and "Musrites," irritated by Prof. van Manen's calm abolition of St. Paul and revolting against the inconsiderate tactlessness of Prof. Schmiedel's article "Mary," will, ignoring the vast overplus of sound and sterling critical learning which is to be found in the book, be driven into the opposing camp of anticritical obscurantism and refuse to hear anything further of Biblical criticism. Thus will the splendid work of critics of the type of the late Profs. Robertson Smith, Tiele and Socin, many of whose articles appear in this volume, of Profs. Driver, Nöldeke and Wellhausen, of President Moore and many others, be discredited by the insistent advocacy of a single overmastering theory for which no convincing proof has yet been furnished by its author, and by the continual display by several of the continental contributors of their ignorance of the fact that in approaching British and American readers on such a subject as the Nativity of Christ or the life of the Virgin Mary the utmost tact is necessary.

We have spoken of Prof. Cheyne's insistent advocacy throughout this volume of the "Encyclopædia" of his Jerahmeel-*cum*-Musri theory, and have described this theory as one for which no convincing proof has yet been furnished by its author. Certainly in the "Encyclopædia Biblica" he has furnished none, either in the article "Jerahme'el" in vol. ii. or in the present volume. For a convenient summary of all that is apparently known about the name "Jerahmeel" and the tribe of the Jerahmeelites we may refer the reader to Mr. J. F. Stenning's paragraph on the subject in Hastings' "Dictionary of the Bible," vol. ii. p. 568. The Jerahmeelites were a clan of southern Judæa, mentioned three or four times in the Old Testament; the name Jerahmeel occurs four times (1 *Chr.* ii. 9, 33; xxiv. 29; *Jer.* xxxvi. 26). Prof. Cheyne, however, has built up for himself a vast edifice of pure theory all about the Jerahmeelites, in whom he sees a powerful tribe of Arabian origin equal in importance to, and rivalling, the Israelites. This theory is connected by him with Winckler's unproved theory of the existence of a North Arabian country bearing the same name in the Assyrian records as did Egypt and a land of Northern Syria, *i.e.* "Muṣri," which itself again largely rests upon the unproved theories of Glaser with regard to the age of the "Minæan" inscriptions of Yaman. So Prof. Cheyne pictures to himself hosts of "Jerahmeelites" and "Musrites" constantly warring against Israel, finding them even serving in the armies of Nebuchadnezzar; they were, according to him, constantly the objects of prophetic denunciation for the evil which they had done unto Israel, although at the same time a disproportionate number of the Jewish proper names known to us from the Old Testament are pronounced by him to be of Jerahmeelite origin. But if the Jerahmeelites are only mentioned half-a-dozen times in the traditional text of the Old Testament and the "Muṣrites" may quite possibly never have existed, how does Prof. Cheyne arrive at these somewhat revolutionary conclusions? By a simple process very characteristic of the extreme "higher critic," he merely supposes that the name "Jerahmeel" originally occurred far more in the Old Testament than it does at present, and that it has been constantly substituted and corrupted; he then proceeds to replace the words "Jerahmeel" or "Miṣṣur" (Muṣri) wherever he thinks they ought to stand, and in this way "restores" the text of the Bible in accordance with his theory. Many of his re-substitutions and corrections are founded on more or less ingenious emendations of the text; for others no justification is given; they rest merely on the *ipse dixit* of Prof. Cheyne. This procedure might be excused in a critic of such preeminent standing as Prof. Cheyne, and we would be ready to accept from the mine of his great learning many conclusions the reasons for which were not fully apparent were it evident to us that the steps of his reasoning were tending in the direction of what was both probable and possible; but in the case of "Jerahmeel" we confess that we have very little faith in his reasoning, and in the connected case of the supposed North Arabian *Muṣri* we believe that he has been misled by a hasty adoption of a theory which is in no way accepted by the majority of Assyriologists.

However this may be, it is in any case on the face of it evident that the professor has in the third volume of the "Encyclopædia" allowed himself to be absolutely overmastered by his theory; he sees Jerahmeel everywhere; everything is a corruption or a disguise or a distortion

of "Jerahmeel"; *Amram* is a "development" of "Jerahmeel"; *Abram* is a corruption of "Jerahmeel"; *Levi* is a Jerahmeelite name, for it corresponds to Leah, which is "a fragment of a feminine form of Jerahmeel"; *Maacah* is "a popular corruption of Jeraḥme'el or Jeraḥme'elith (a Jerahmeelitess)," *Meholah* is the same, *Mephibosheth* (*col.* 3023), *Michael*, *Abihail* (*col.* 3198), *Jerubbaal*, *Ephrath* (3516), *Rimmon* (3379), *Ramah* (3264), *Jericho* (3258), *Hiddekel*, *Leummim* all apparently occur as corruptions of, or substitutions for, "Jerahmeel." In the majority of cases it is impossible to discover how or why. "Both *Micha* and *Chimham* [the italics are ours] (2 S. 19, 37 *ff.*) may quite naturally," says Prof. Cheyne (*col.* 3025), "be traced to Jeraḥme'el"; *Ebed-melech* ought to be "Arāb-jerahmeel" (3340); the *Nephilim* were really Jerahmeelites, for *Nephilim* = "Rephilim" = "Jerahmeelim"; and after this the transition *Nemuel*—"Jemuel"—"Jerahmeel" is comparatively easy! Further, *Amalek* is "an early popular distortion" (2935) of, and "ultimately the same name" (3258) as, "Jerahmeel." The inevitable Jerahmeel pursues us even into the Garden of Eden. In *Gen.* ii. 8 "we cannot hesitate to read 'Yahwê [Elohim] planted a garden in Eden of Jerahmeel'"; the traditional text reads, "And Yahwê [Elohim] planted a garden eastward in Eden." According to Prof. Cheyne there is a "Jerahmeelite form of the story" of Paradise (3574), and the passage *Gen.* iii. 20 probably ran originally, "And Jerahmeel called the name of his wife Hôrîth, that is, a Jerahmeelitess." The original names of Adam and Eve were, therefore, not Adam and Eve, but "Jerahmeel" and "Hôrîth." We cannot find that any real reasons are given for all these assumptions.

Dr. Winckler's hypothetical North-Arabian "Muṣri" is pressed into service in much the same way. Here is the traditional text of *Deut.* xxxiv. 1 side by side with Prof. Cheyne's version of it:—

Traditional Text. (R. V.)

"And Moses went up from the plains of Moab unto mount Nebo, to the top of Pisgah, that is over against Jericho. And the Lord shewed him all the land of Gilead, unto Dan, and all Naphtali, and the land of Ephraim, and Manasseh, and all the land of Judah, unto the hinder sea: and the South, and the Plain of the valley of Jericho the city of palm trees, unto Zoar."

Prof. Cheyne's Version.

"And Moses went up from Arabia of Muṣri to the top of the mountain of the Negeb of Jerahmeel [fronting Jerahmeel].[2] And Yahwê shewed him Jerahmeel as far as Dan, and all Tappūḥim [the land of Jerahmeel and Muṣri], all the land of Judah as far as the Jerahmeelite sea,[3] and the Negeb of Jerahmeel [the land of Jerahmeel, the land of Muṣri]."

Prof. Cheyne's note [2] is to the effect that the words in square brackets are to be regarded as glosses; note [3] states that this is the true original name of the Dead Sea.

Because, relying on his own arbitrary interpretation of ii. *Chron.* xxi. 16, Dr. Winckler boldly supposes a North-Arabian Kush as well as a North-Arabian Muṣri, Prof. Cheyne naturally follows, and so we find that the name of *Nehushta*, the mother of Jehoiachin, is corrupt; it ought to be "Cushith," a North-Arabian: her father was "Elnathan of Jerusalem"; this is very unlikely; "Elnathan" is of course wrong, and "Jerusalem" is in this passage a corruption of Jerahmeel! Of course Prof. Cheyne does not mean a corruption in the sense in which the word "lord" is a corruption of "hlaford"; he means that the text has been more or less wilfully altered from the supposed original "Jerahmeel" to the existing "Jerusalem." But he gives no real proof of any such corruption or of the validity of his supposition that the original text read "Jerahmeel."

Mordecai follows the rest; *Paddan-aram* ought to read "Ḥaran (Ḥauran?) of Jerahmeel" (3523); *Daniel* "is most easily explained as a corruption of Jerahmeel," and with Daniel go *Babel*, *Nebuchadnezzar* and *Belshazzar*, the real original of the latter having been a hypothetical "Baal, prince of Miṣṣur" (3983). For Prof. Cheyne's apparent belief that the names of Nebuchadnezzar and Belshazzar have, in the Book of Daniel, been substituted for those of his hypothetical North Arabian heroes, and that the *mise-en-scène* of the story of Daniel is to be bodily transferred from Babylonia to the Negeb of Jerahmeel, no proof whatever is given.

The reader is invited to compare the accepted text of *Jer.* xxxix. 1 with Prof. Cheyne's version of it; *Nergal-sharezer* is, according to him, a corruption of "Mergal-sharezer" (!) which "proceeded from" '*shar Yerahme'el shar Miṣṣur*,' "the king of Jerahmeel and the king of Miṣṣur." He turns the Babylonian Nergal-shar-utsur, the Rab-mag, and other Babylonian officials into princes of Jerahmeel, Miṣṣur, Nodab, Cushim and the Arabians For these extraordinary proposals not the slightest justification is given.

For Prof. Cheyne the Book of Obadiah seems to contain a kind of Bacon-Shakespeare cryptogram all about Jerahmeel, and this is how he, with apologies for doing so, it is true, recasts the well-known sentence from Psalm cxxxvii.: "On the heritage of Jerahmeel we wept, remembering Zion." In Psalm cx., Prof. Cheyne restores an original text for verses 5-6 (R. V.), "The Lord at thy right hand shall strike through kings in the day of His wrath; He shall judge among the nations, He shall fill the places with dead bodies, He shall strike through the head in many countries," as follows:—

"The Lord will shatter Jerahmeel in the day of His wrath, He will judge mighty kings for the treason of their pride. The Lord will smite Geshur on the land of the Arabians; the kings of Rehoboth He will destroy, the princes of Jerahmeel."

It may be admitted that the received text is here corrupt, but we cannot see that the corruption goes very far or think it probable that the original sense of the passage quoted was very different from its present tenour; even as it stands, it is not nonsense, any more than is the Pisgah passage quoted above.

Finally, we may compare the received text of *Gen.* x. 10 *ff.*, describing the kingdom of Nimrod, with Prof. Cheyne's version of it:—

Traditional Text. (R. V.)

"And the beginning of his kingdom was Babel, and Erech, and Accad, and Calneh, in the land of Shinar. Out of that land he went forth into Assyria, and builded Nineveh, and Rehoboth-Ir, and Calah, and Resen between Nineveh and Calah. . . ."

Prof. Cheyne's Version.

"And the beginning of his kingdom was Jerahmeel in the land of Seir. From that land he went forth into Geshur, and smote Hebron, Rehoboth, Jerahmeel, and Beersheba, which is between Hebron and Jerahmeel."

In this passage we have a plain statement of a legendary account of the origin of the kingdoms and cities of

Mesopotamia, the foundation of which is in the legend ascribed to a half-mythical hero called Nimrod. It is impossible to see what grounds there are for any radical alteration of the text, yet Prof. Cheyne arbitrarily assumes that all the Mesopotamian names in the passage quoted are substitutions for names of obscure places to the south of Judæa, and he apparently does so merely because Nimrod is called a son of Cush, and Dr. Winckler thinks there was a country called Cush in northern Arabia. In this case we cannot but reject Prof. Cheyne's alterations, which seem to us entirely arbitrary, unnecessary and improbable.

We have by no means given a full list of the passages in the "Encyclopædia" which Prof. Cheyne devotes to "Jerahmeel" and the names which he would identify with it, but further enumeration would be wearisome. Space, too, fails us wherein to recapitulate the obvious arguments against the wildest of all Prof. Cheyne's proposals, *i.e.* to explain *Goshen*, *Pithom* and *Raamses* as names, not of Egyptian places, but of "the Negeb of S. Palestine or N. Arabia" (*col.* 3211), and so to deny, in effect, that there ever was any Israelitish sojourn in, or exodus from, Egypt at all, the exodus having been, according to him, an exodus, not from Egypt, but, of course, from the other country of the same name in northern Arabia! (see the article "Moses"). But here again Prof. Cheyne is merely following Winckler, whose theory on the subject he regards as "at any rate very plausible" (*art.* "Mizraim," *col.* 3163).

Now Prof. Cheyne is, of course, at liberty to hold this theory if he pleases, and to connect it with the equally vague and unestablished theory of Dr. Winckler about the "North-Arabian Muṣri" or with any other theory he pleases, but it is doubtful whether he ought to state it with such assurance of its validity in a work of this kind, which was intended to give its readers the matured results of a reasonable criticism, not necessarily the latest theories all hot. Prof. Cheyne has, however, in the majority of cases chosen to give his readers mere neoteristic theories instead of solid and *certain* additions to knowledge.

We cannot find that any of his colleagues have adopted Prof. Cheyne's views on the Jerahmeel question, with a single exception, and that a most unexpected one. It was rather startling to find the name of Mr. T. G. Pinches set down as that of one of the contributors to a dictionary which was designed to set forth the views of the higher critics and is partly edited by the most extreme critic of them all, for Mr. Pinches has hitherto been conspicuous for his resolute adherence to the opposing school of sentiment on these matters, and has, indeed, always been looked upon as a pillar of evangelical orthodoxy; but now, not only do we find Mr. Pinches writing an article in a heterodox encyclopædia, we even find him apparently accepting Prof. Cheyne's most heterodox theory, and admitting into his article the statement that "'Pul' or 'Phaloch' may be a corruption of Jerahmeel." The remark about a "southern Asshur" in northern Arabia, which occurs just above this, must be due to Prof. Cheyne, but Mr. Pinches ought not to have allowed it to appear in his article without comment. Apparently the land *Ašr* mentioned in the Minæan inscriptions *Gl.* 1083, 1155 (6th century B.C.) is meant; this may be Assyria itself, if it is not the land of Asir in *western* Arabia, between al-Ḥeǧâz and Yaman. Mr. Pinches's alternative suggestion that Tiglath-Pileser III. may have received the name "Pul" "on account of the Babylonian opinion of his character (cp. Ass. *bûlu*, 'wild animal')" cannot be accepted, because *bûlu* is a generic term for "cattle," and we do not suppose that any sensible Babylonian would have called a king or anybody else "a cattle."

However, although we may regret that this volume of the "Encyclopædia Biblica" has been made the vehicle of a wild and unproven theory, or rather group of theories, we ought not to allow this regrettable fact to prejudice us against the volume as a whole. When Prof. Cheyne can free himself from the baneful influence of "Jerahmeel" his work cannot be bettered; witness his article "Ophir," which finally disposes of the idea, started and still maintained by persons with but little archæological knowledge, that Mashonaland is Ophir. The article of Profs. Nöldeke, Buchanan Gray and Kautzsch on "Names" should be carefully read; it is of great interest and value. Prof. Driver's article, "Mesha," is thoroughly exhaustive and extremely interesting; we cannot but regret that only a single contribution from his pen is to be found in this volume. The articles "Persia" and "Philistines," by the late Prof. Tiele and Prof. F. Brown, and by President G. F. Moore respectively, are of the first order, especially the latter, which is thoroughly up to date, the author agreeing with all those writers who have recently treated of the subject in believing the Philistines to have been certainly of European, and probably of specifically "Ægean," origin. The traditional view that they came from Crete is borne out on the one hand by the Egyptian records of the wars and alliances of the *Purusati* and on the other by the lately ascertained fact that the "Mycenæan" culture had obtained a foothold in Philistia at some time between the fifteenth and twelfth centuries B.C. In this connection, Mr. J. L. Myres's remarks on Mycenæan finds in Philistia and on the influence of Ægean pottery-types on the native styles should be noted (art. "Pottery").

Prof. Eduard Meyer's "Phœnicia" is worthy of so distinguished a historian; Mr. W. M. Müller's articles on subjects connected with Egypt are, while critical, at the same time moderate, careful and informing. Evidently he will not have anything to do with the Jerahmeelite theory; he still believes Pithom to be Pithom in the Wady Tûmilât, and holds with the rest of the world that the Israelites once lived in the land of Goshen, which was in Egypt.

The Rev. C. H. W. Johns must also be congratulated on his non-adherence to the Jerahmeelite theory; at any rate, he treats *Gen.* x. 8 *ff.* as referring to Mesopotamia, not to Jerahmeel, and evidently continues to think that "Nineveh" means Nineveh and not Hebron (see above). His article "Nineveh" is good; we find nothing to object to in it except the statement that "Sir H. Layard by his explorations definitely fixed" the city "at Kuyunjik (1845-47 and 1849-51)." As a matter of fact, he claimed by his excavations to have proved that *Calah* was the site of Nineveh, and it was only after Hincks, Rawlinson and others had deciphered the inscriptions that the earlier

view of Rich, duly mentioned in its place by Mr. Johns, was shown to be correct.

Other articles which may be highly commended are those of Prof. Deissmann on "Papyri," which contains a most valuable discussion of the character of New Testament Greek, of Dr. Benzinger on "Law" and "Passover," of Prof. Prince on "Music," besides various contributions by younger English Semitic scholars, *e.g.* Mr. S. A. Cook and Mr. Maurice Canney. We also welcome several short contributions by Sir W. T. Thiselton-Dyer on botanical subjects and a paragraph on the flora of Palestine by Mr. H. H. W. Pearson.

We have touched but superficially upon the many articles in this volume which deal with New Testament criticism. It is a highly controversial subject, and if things have to be said which are likely to shock the feelings of the average Christian, they should at least be said as tactfully as possible. But it cannot be said that we find much tact in the contributions, already referred to, of Profs. van Manen, Usener and Schmiedel, for example. This is a pity, for it prejudices readers in this country against this kind of critical work, which, though often exaggerated in its methods and not seldom self-contradictory in its conclusions, is still deserving of careful attention and study.

The general editing of the "Encyclopædia" could be improved with advantage. The highly laudable aim of employing only specialists in certain branches of biblical knowledge to deal with questions connected with their own special studies has resulted in a certain irritating choppiness of treatment. Thus we get an article, "Purim," of which five paragraphs are written by Mr. Johns, one by Mr. Frazer and one by Prof. Cheyne. Mr. Johns tells us all he knows about the possibility of a Babylonian origin for the feast; Mr. Frazer discusses Mordecai and Marduk, Vashti and Esther and Ishtar, the mock-king of the Sacæa and the king and queen of the May; and Prof. Cheyne implies that Mr. Frazer is all wrong, because there never were any such names as Mordecai and Esther, which are simply corruptions of Jerahmeel and "Israelith," and the book of Esther originally referred, not to Babylonia or Persia, but "to *a captivity of the Jews in Edom*" (italics in original). At least, we understand that Mr. Frazer wrote § 6 of this article; it is signed with his initials. But a fact which militates against this theory is that in the paragraph in question "J. G. F." refers to himself always in the third person—J. G. Frazer thinks this or J. G. Frazer thinks that—and an editorial note at the bottom of *col.* 3980 says that the editors "have no hesitation in appending a sketch of J. G. Frazer's view. . . ." Is it their sketch or is it Mr. Frazer's? If it is theirs, why is it signed "J. G. F."? Prof. Cheyne often adds paragraphs with remarks of his own, chiefly about Jerahmeel, to the work of other contributors; one conspicuous instance is in the article "Moab," by Profs. G. A. Smith and Wellhausen, which is followed by Prof. Cheyne for two columns with an addendum correcting Wellhausen's work in accordance with the supposed results of the latest criticism, *i.e.* Muṣri and Jerahmeel.

The faults of this volume are, then, many and great, but, we repeat, this fact ought in no way to detract from the inestimable value of the immense overplus of sound learning which is to be found in it. Prof. Cheyne's own articles do not all stray into the paths of Jerahmeel by any means, and the large majority of the other contributors, who show no trace of Jerahmeelite influence, are experts in their own particular branches, and their splendid work must be regarded as redeeming the "Encyclopædia" from many of its faults.

The publishers have done their utmost; the typography and general get-up of the book are first-rate: it is a pity that their efforts should be so severely handicapped by the wild theorising of one of their editors and by the tactlessness of some of their less notable foreign contributors.

In conclusion, a word of commendation must be given to the excellence of the proof-correcting; we have hardly discovered any errors in this regard. A slip of the pen left uncorrected is, however, noticeable in *col.* 3165, *l.* 2 from the top, where "al-Miṣr" should read simply "Miṣr." The phrase "al-Miṣr" does not, apparently, occur in the Himyaritic (Minæan) inscription *Gl.* 1155 (= *Hal.* 535) which is here mentioned; only "Miṣr" or "Miṣran" is spoken of, the latter expression = al-Miṣr.[1]

THE FORAMINIFERA.

The Foraminifera, an Introduction to the Study of the Protozoa. By Frederick Chapman, A.L.S., F.R.M.S. Pp. xv + 354. (London: Longmans, Green and Co., 1902.) Price 9*s.* net.

THE contents of this book may be divided into two parts, general and special. Beginning with the latter, we find presented in a convenient form (chapters vii.-xvi.) an account of the families and genera of the Foraminifera. One species of each genus is described and figured, the conditions of its occurrence and its palæontological history being also given. The figures are reproductions of pen and ink sketches, and in most cases will no doubt enable the student to refer his specimens to their proper genera. Some are, however, too indefinite to serve even this purpose, and the attractiveness of the book would have been increased if more care had been taken to give something of the elegance and finish of the natural objects.

In dealing with the phenomenon of the occurrence of two or three plans of arrangement of the chambers which is presented by many forms in the growth of the individual test, the use of the words *bimorphous* and *trimorphous* is advocated. The terms dimorphic and trimorphic were originally applied to such tests, but now that it is recognised that the species of the Foraminifera present themselves under two forms, arising by different modes of reproduction, the words dimorphic and dimorphism have been, in accordance with customary biological usage, employed in the latter sense. Fresh words are therefore needed, as the author points out, for the use to which

[1] That Egypt, by the way, is here meant, and not any place in North Arabia, is evident from the inscription itself, which obviously contains a reference to the conquest of Egypt by Cambyses. We are strongly of opinion that M. Hartmann's dating of this inscription in *Zeitschr. für Assyriologie*, x. (1895), p. 32, is absolutely correct. Weber's defence (*Mitteilungen der Vorderasiatischen Gesellschaft*, 1901, 1, p. 22 *ff.*) of Glaser's later view, as altered and amplified by Winckler and Hommel, is weak. Weber also, like Prof. Cheyne, takes the existence of a North-Arabian Muṣri for gospel; we prefer to wait till Dr. Winckler has proved its existence, which he has not yet succeeded in doing, before we accept it.

these terms were originally applied. But *bimorphous* and *trimorphous* are objectionable, not only on account of the clumsy and hybrid character of the former, but because they may be taken to imply, by analogy with the use of the terminations *ous* and *ic* in chemistry, some relation with the phenomenon of dimorphism. The Latin equivalents *biformed* and *triformed* proposed by Rhumbler [1] are far preferable.

The most valuable part of the book as a contribution to the literature of the Foraminifera is the chapter on their geological range. Twenty years ago, Schwager summarised the information which had been accumulated on this head in the article appended to Bütschli's account of the Sarcodina in Bronn's Thier-reich. Since that date our knowledge has greatly extended, and to no inconsiderable extent as the result of Mr. Chapman's own investigations. The chapter ends with a tabular view of the range of the several families, in which it appears that all the main ones were represented in the Primary rocks, and that four of them (Textularidæ, Lagenidæ, Globigerinidæ and Rotalidæ) have been found in Cambrian strata.

The descriptive part of the book ends with useful practical directions, but no mention is made of the microaquarium, which has yielded such excellent results in the hands of Schaudinn, who invented it.[2]

The earlier chapters purport to give, as implied in the title, an introduction to the study of the Protozoa in general and of the Foraminifera in particular; and it is undoubtedly most desirable that workers in this group should have their eyes open to the general biological bearing of the phenomena which lie before them. To attain this end they must, however, go elsewhere. In these chapters there is no grasp of the problems presented, or of the conclusions which have been arrived at. On p. 11 we are told that the division of the nucleus "takes place either by the simple process of binary division or by the more complex and beautiful process of karyokinesis." The author thus ignores the process which has been observed in several of the higher forms (though it is, indeed, alluded to and figured further on), namely, the simultaneous breaking up of the nucleus or nuclei into fragments. Continuing the same sentence, the karyokinetic division of the nucleus is described as a process "in which the nuclear body is invested with strands of chromatin threads,"—whatever that may mean; but on turning to Fig. 10, which is given in illustration, we find two figures from Schaudinn's paper on the "Central-Korn" of the Heliozoa (*Verh. deutsch. zool. Gesellschaft*, Bonn, 1896), which represent stages, not of the karyokinetic division of the nucleus at all, but of the division of the central granule, a process preliminary to karyokinesis.

In chapter iv., on the shell structure of the Foraminifera, the author is more at home, but it opens with the statement that the arrangement of the segments of the shell is partially determined by the form of the initial or primordial chambers. The primordial chambers, whether they be microspheric or megalospheric, are nearly always globular or ovoid, whatever the arrangement of the succeeding chambers may be. How then can the arrangement be in any degree determined by their form?

We cannot pass over the omission (p. 53) of the name of Max Schultze, the author of the classical work "Ueber den Organismus der Polythalamien," from the list of those who since Dujardin have been pioneer workers on the group.

On the whole it must be confessed that the book is written in a slip-shod style, which in these earlier chapters is very marked; and in closing it one cannot but feel that the author would have been better advised if he had confined himself to the special treatment of the subject, for which he is well qualified, leaving the larger biological problems to other hands. J. J. L.

[1] "Entwurf eines naturlichen Systems der Thalamophoren." (*Nachrichten der K. Gesellsch. d. Wissenschaften zu Göttingen. Math.-phys. Klasse*, 1895, Heft 1, p. 63.)

The reader is left in doubt as to the precise term advocated by the author, for on p. 48 "dimorphous" is used, but on p. 164 the word has become "bimorphous."

[2] "Ein Mikroaquarium." (*Zeits. f. wiss. Mikroskopie.* Bd. xi., 1894, p. 326.)

UNORGANISED FERMENTS.

Enzymes and their Applications. By J. Effront. Translated by S. C. Prescott, S.B. Vol. i. Pp. xi + 322. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd.) Price 12*s.* 6*d.*

IN his work on "Enzymes and their Applications," Dr. Effront has presented us with book of great interest and value. The book, as he explains in his preface, is "a summary of the course at the Institute of Fermentation of the New University of Brussels." If the lectures are delivered in the style in which the book is written, we should very much like to be among his students.

Judging from his definition of an enzyme, Dr. Effront is in practical agreement, although he does not say so, with those who class the enzymes among catalytic agents. His definition is as follows:—

"The enzymes, soluble ferments, zymases or diastases are active organic substances secreted by cells, and have the property, under certain conditions, of facilitating chemical reactions between certain bodies without entering into the composition of the definite products which result."

But although it seems appropriate to class the enzymes with catalytic agents, yet there are certain substances which appear to have a catalytic action upon the enzymes. For example, on p. 118 it is stated that the addition of 50 milligrams of asparagin to starch which has been treated with amylase increases the saccharification, in a given time, nearly seven-fold.

In chapter iii., which treats of the "Manner of Action of Diastases," the different theories advanced to explain diastatic action are carefully reviewed. As an example we may cite the theory of Arthus, who, relying upon the discrepancies which exist between the accounts of many authors as to the properties of the various diastases, takes up the position that enzymes are not substances, but are properties of substances. Enzymes, indeed, bring about chemical changes, but so also do light, heat and electricity. Magnetism is a property of magnetised substances such as steel, but it cannot be obtained apart from the substance. The same reasoning applies to enzymes, which are only the properties of the substances obtained by precipitation or other means, and therefore a pure enzyme is impossible. On p. 66 Dr. Effront shows

how extremely sensitive the enzymes are to antiseptic and toxic substances; we have not heard of magnetism or electricity being affected in a like manner. But whatever the truth may be, it cannot but be admitted that our present knowledge as to what diastatic action really may be is incomplete and vague in the extreme. Possibly the elucidation of many of the difficulties will follow the preparation of a pure enzyme.

One difficulty encountered in studying the enzymes is the multitude of names which a single enzyme may possess, *e.g.* on p. 51 we are told that sucrase is variously called "glucose ferment, cytozymase, zymase and invertin." The chief reason for this diversity of names is that different investigators, having obtained from different sources a diastase capable of transforming cane sugar into invert sugar, have often been under the impression that they have come across a new diastase and have therefore invented a name for it.

Chapters v. and vi. deal with sucrase from a theoretical aspect, and chapter vii., on the fermentation of molasses, introduces us to the technical portion of the work. Although sucrase is not prepared commercially, it plays a very important part in fermentation, especially in the manufacture of alcohol from molasses.

Dr. Effront has evidently studied the technical part of the question with the same care which he has devoted to the scientific side. As a consequence the chapters on the technology of the enzymes should be very valuable to those interested in this branch of the subject. The space at our disposal forbids us to more than briefly notice some of the important applications of enzymic fermentation. There is an interesting chapter on "Panary Fermentation," and here one cannot but be struck by the fact that although the art of bread-making is one of great antiquity, yet we know very little as to what really does take place in the process of bread-making.

Chapter xviii. deals with the industrial application of "maltase" (the ferment of maize, which also occurs in small quantities in yeast) and the manufacture of glucose.

Chapter xxi. should be of great interest to chemists, as it treats of the "Ferments of Glycerides and Glucosides." Among the various enzymes here discussed, we notice "lipase," the active principle of the pancreatic juice, "emulsin," which occurs in almonds, and "erythrozyme," the ferment contained in the madder root. This chapter might with advantage have been extended, but, unfortunately, our knowledge of these very interesting substances is not yet very far advanced.

In conclusion, we must not forget the translator, Mr. Samuel C. Prescott, who has carried out his labours in a most satisfactory manner. F. MOLLWO PERKIN.

OUR BOOK SHELF.

Astronomischer Jahresbericht. By Walter F. Wislicenus. Band iii. Pp. xxxi + 671. (Berlin: Georg Reimer, 1902.)

THE value of this work to astronomers and others interested in astronomical matters is now so well known, in spite of this being only its third appearance, that the present issue will be warmly welcomed. In the compilation of such an undertaking as this, Dr. Wislicenus and his co-workers are to be heartily congratulated, for they have brought together a very great number of most useful references and excellent brief extracts of all the more important publications of the past year. The volume now contains 671 pages, and the compiler informs us that this will probably be about its normal size. The second volume contained 552 references more than the first one, and the one before us shows an excess over the second by 193 references. This latter excess was chiefly due to the great number of papers on Nova Persei, which required 228 references alone. In future, to keep down the number of such references, the compiler proposes to include under one reference all those publications which appear during a year under the same heading and by the same author. This seems a very rational suggestion.

It may be mentioned that references are not only given to all the original publications, but also to all translations of such publications and astronomical articles which have appeared in various quarters. Thus, to take a case in point, we find that the communication by Dr. J. Hartmann to the *Sitz. der Kgl. preuss. Akademie der Wiss. zu Berlin* on "The movement of the Pole Star in the line of sight" was translated into English in the *Astrophysical Journal*, and was noticed in *Sirius*, *Die Natur*, *Astronomische Rundschau*, *Das Weltall* and the *Revue Scientifique*, their respective references being added in each case.

The book concludes with a capital index of names and brief tables of errata to the second and present volume. In addition to those mentioned in the present volume, which, by the way, are remarkably few in number considering the work involved, may be added "Norman" instead of "Normann" in references Nos. 1454 and 2131, and "nächste Maximum" instead of "jetzige Minimum" in reference number 1510.

In conclusion, it is hardly necessary to point out that no astronomical observatory or similar institution should be without this volume, which embodies in it all that relates to the recent progress of astronomical science, not only in this country, but over the whole world. That the work has in its third year become so complete is due to the untiring labours of Dr. Wislicenus and his co-compilers, and it is hoped that such may in the future be lightened by the endeavour of all interested in such a useful undertaking to remember to send them separate copies, reprints, &c., of published papers.

W. J. S. LOCKYER.

Elements of Metaphysics. By J. S. Mackenzie. Pp. xv + 172. (London: Macmillan and Co., Ltd., 1902.) Price 4*s.* 6*d.*

PROF. MACKENZIE is to be congratulated on having produced an exceedingly useful little book of a kind which has no precise counterpart in our current philosophical literature. Within the compass of less than two hundred small pages he deals very suggestively with the nature of the metaphysical problems, the methods of metaphysical science and its relation to the rest of our theoretical and practical interests, science in general, art, ethics, and religion. The aim of his discussion is not so much to indicate conclusions as to lead his reader to comprehend the nature of the problems to be solved and the methods of solution which are at our command. Hence the beginner in philosophy could hardly have a better introduction to what is, after all, the main business of philosophy, the practice of thinking intelligently for himself on the ultimate problems of knowledge. So far as the author's own conclusions in philosophy are put forward, they indicate a rare catholicity of view with a certain bias in favour of the line of thought, represented by Aristotle and Hegel among the great names of metaphysics, which insists upon development as the key to the understanding of the forms of existence. As might be expected from his choice of philosophical masters,

Prof. Mackenzie is an idealist in his general position, though he evidently realises the difficulties which beset an over-hasty idealism, and states his result in an avowedly tentative form. A. E. T.

Histoire des Mathématiques dans l'Antiquité et le Moyen Age. Par H. G. Zeuthen. Traduite par J. Mascart. Pp. xvi + 296. (Paris: Gauthier-Villars, 1902). Price fr. 7.

THIS translation of Prof. Zeuthen's well-known and deservedly popular work has been revised by the author, and several interesting notes have been added by M. Paul Tannery. The greater part of the volume deals with the mathematics of the Greeks, especially their geometry; the Elements of Euclid, in particular, are analysed in considerable detail, and discussed with intelligence and sympathy. Conservatives who still rally to the cry of "Euclid, and nothing but Euclid," may be respectfully invited to study, with the help of such comments as Prof. Zeuthen's, the actual text of the Elements, which is now easily procurable in Heiberg's excellent edition. It ought, on the one hand, to increase their admiration of the Greek geometer, and, on the other, to convince them of the absurdity of supposing that a garbled travesty of a portion of his work is the best introduction to geometry to put into the hands of the English schoolboy. Another interesting section is that which deals with the mathematics of the Arabs. It is difficult to claim for them any very substantial contributions to the science; but they showed themselves apt pupils both of the Greeks and of the Indians, they kept the study of mathematics alive when Christian Europe was passing through its darkest age of ignorance and superstition, and they powerfully helped on the subsequent revival. To Moslem scholars, and their enlightened rulers, modern Europe owes a debt which is not always sufficiently realised. M.

A la Conquête du Ciel! Contributions Astronomiques de F. C. de Nascius, en Quinze Livres. Livre Deuxième (fascicule 6 et dernier.) Pp. 84. (Nantes: Imprimerie-Libraire, Guist'hau, 1902.)

M. F. C. DE NASCIUS has favoured us from time to time with copies of his astronomical contributions, which are to extend when complete to fifteen volumes. Since each volume consists of numerous parts, it will be easily understood that no inconsiderable task awaits the reader who aspires to a complete mastery of the author's methods and teaching. Only one small part of the second volume lies before us, but we confess that we are utterly unable to comprehend its purpose or to do justice to the ingenuity that apparently underlies its construction. The general conception seems to be remotely connected with Bode's law, but is far more difficult of apprehension, for with this is connected a discussion of the "triangle of divine harmony," while over the whole hovers a bewildering but awe-inspiring theme which is expressed as algorithmic. It will, perhaps, be sufficient to say that the object of the author, if object he has, is by some simple manipulation of figures to produce quantities that shall approximate to various astronomical constants, such as the periods and distances of the planets. For example, he sets out to establish or reproduce the period of sunspots, which he gives at 11·11 years. The triangle of divine harmony is, we are assured, admirably adapted for this species of discussion. This triangle happens, fortunately, to be right-angled, and two sides have the values 69 and 17·89. There is a good deal about the number 69, which we are very solemnly assured is equal to 64 + 5, and it is no doubt entirely one's own fault if he fails to correctly apprehend its true significance, but 17·89 seems to be introduced here for the first time, at least in this volume, and one may be excused if he fails to perceive its actual bearing. Our author handles these quantities in the following way. The area of the divine triangle is first found, this is then doubled to get a parallelogram, and the side of a square found the area of which is equal to the tenth part of that parallelogram. This side has for its numerical value 11·110! and the author congratulates himself on his success.

For many years, we are afraid, M. de Nascius has laboured on similar lines, which are destined to bring him or his readers little profit, but which he will no doubt pursue so long as he can trace his figures. It is nearly thirty years, he tells us, since he first placed a hesitating foot on the path which was destined to lead him to such brilliant discoveries. Let us hope that he has been frequently cheered by finding some close coincidence between his calculations and observed facts, and that his delight has been as keen as that experienced by other physicists who have trod a more legitimate road and been led to more valuable results.

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 intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Mr. Marconi's Results in Day and Night Wireless Telegraphy.

READING a brief account of these results in the *Times* of June 14, I perceive that Signor Marconi advances in explanation of the greater distance at which night signals were received, that the day signalling is affected by diselectrification of the transmitting elevated conductor.

If—as I gather—Signor Marconi is referring to his observations made at positions in the Atlantic, west of England, the waves travelling westward, may not æther drift in the earth's orbital path be concerned in producing the effects observed?

The waves advancing against the orbital æther stream in the day time, with it at night, might be supposed to give rise to conditions analogous to those which affect the transmissibility of sound against or with a high wind. It will assist if we assume a retarded æther drift near the earth's surface and free motion above. But still, the difficulty in this explanation resides in the very great magnitude of the effects observed.

I write merely by way of suggestion, and in very considerable ignorance of almost every particular involved in this explanation.

J. JOLY.

Geological Laboratory, Trinity College, Dublin, June 17.

Remarkable Sunsets at Madeira.

THE last few evenings we have witnessed here some beautiful sunsets, closely resembling the sunsets observed after the Krakatoa eruption, which I remember well, *i.e.* there is the same large area of beautiful pink haze in the west and high up in the sky at and immediately after sunset. The first sunset which I felt certain was of the above character I noticed on Friday, June 6. On June 10 and yesterday the display was particularly striking. There were indications, I believe, of the pink glow on one or two evenings before June 6, but as there were a good many clouds about it was difficult to feel certain of the special character of the sunsets. F. W. T. KROHN.

Funchal, Madeira, June 12.

THE INSTITUTION OF ELECTRICAL ENGINEERS' DEPUTATION ON ELECTRICAL LEGISLATION.

WE published an article a short time ago (NATURE, vol. lxvi. p. 35) on the report of the committee appointed by the Institution of Electrical Engineers to inquire into the cause of this country's backwardness in electrical industries, and stated that it had been decided to ask the Prime Minister to receive a deputation on the subject. This deputation, after being once or twice postponed, waited upon the President of the Board of Trade, the Right Hon. Gerald W. Balfour, M.P., on

Tuesday, June 17. A number of influential members of the Institution were present, including Mr. J. Swinburne (president), Lord Kelvin, Prof. J. Perry, Prof. S. P. Thompson, Colonel R. E. Crompton and Mr. S. Z. de Ferranti.

Lord Kelvin having introduced the deputation, Mr. Swinburne gave a clear statement of the case. He pointed out that local authorities had become involved in electrical enterprise through what was in reality only an accident, namely, that the laying of mains involved opening up the streets. As a result they had obtained legal powers which were not always used properly or in the interests of the community. Even a municipality acting in the true interests of its own ratepayers need not necessarily be doing what was best for the country at large. It was, moreover, now possible to carry out electrical undertakings on a scale that was not contemplated when the Acts by which they are governed (the Electric Lighting Acts of 1882–1888 and the Tramways Act of 1870) were passed. They urged, therefore, that the whole question of electrical legislation should be reconsidered by the Government with special reference to the right and advisability of allowing the municipalities to retain their present powers. This question concerned the Government as a whole, but there was also a matter concerning the Board of Trade in particular. It was thought that there should be a larger electrical staff to enable the Board of Trade to deal more satisfactorily with modern developments. Many of the regulations were behindhand, and it was thought desirable that some questions, such as the use of overhead wires, the size of transformers, &c., should be reopened.

Other speakers followed, including Colonel Crompton, who cited the case of Hove as one in which the Corporation had done its best to thwart the efforts of the company which was supplying electric light. Mr. Ferranti laid stress on the desirability of allowing the use of overheadwires so that the capital expenditure of pioneering schemes might be diminished, and urged greater flexibility in the Board of Trade regulations generally. It was finally agreed that the Institution of Electrical Engineers should go through the regulations and make recommendations to the Board of Trade on the points which electricians consider require amendment.

Mr. Gerald Balfour, in replying on the main question, admitted England's backwardness, but doubted whether it was entirely, or even chiefly, due to the cause alleged. We had to contend in England with the conservatism of strongly developed interests. He did not question, however, that the existing legislation was capable of amendment, and two Bills had already been drafted, one dealing with electric traction and the other with electric lighting. The Traction Bill was to give effect to the recommendations of the departmental committee appointed by the Board of Trade, and he hoped it would prove a satisfactory compromise between the wishes of promoters and municipalities. The Lighting Bill was based on the recommendations of the House of Commons Committee of 1898, which advised considerable modifications of the existing laws. He could not, however, hold out any hope of either Bill being passed this session. Mr. Swinburne asked that the whole question might be considered by a Royal Commission, and Mr. Balfour replied that he would be willing to consult the Cabinet, but could not say, without further consideration, whether he should recommend the suggestion to be adopted.

It need scarcely be said that this promise is quite insufficient to satisfy the urgency of the case. Indeed, the spirit of the reply to the deputation is not what should inspire statesmen who desire to encourage national progress. It is conceded that the obstacles to electrical development in this country are serious, and that they prevent our electrical engineers from keeping the nation in the forefront of progress. The obvious duty of an enlightened Government is to insist that difficulties in the way of industrial advances must be removed; or, at any rate, encouragement should be given to those who have to overcome them. Instead of this, our statesmen find excuses for the barriers across the road, and are eager to show reason why no attempt should be made to break them down.

Such justification as Mr. Gerald Balfour gave for masterly inactivity is almost sufficient to make anyone abandon hope that departmental officials will ever understand the needs of science and technical industries. What do they know of progress whose only desire is not to interfere with vested interests? Any advances that are made in England are due to the restless men who have in them the spirit of evolution and who force development in spite of unsympathetic circumstances. But we cannot hope to keep in line with other progressive nations unless the conditions for improvement are made more favourable. In commenting upon the apathetic spirit in which Mr. Gerald Balfour met the deputation, the *Times* referred to our leeway in electrical industries and expressed the views of many thoughtful men as to the need of making it up. The remarks are worth reproduction here, because they show that the position taken by the Government is one from which the interests of science and industry cannot be seen.

It is not merely by America that we have been completely beaten in electrical engineering. We are far behind continental countries as old as ourselves and having quite as many vested interests to deal with. The reason is that every continental Government keeps in touch with the best knowledge of the day, and habitually consults, upon every question involving the application of science, the highest scientific authorities it can find. Had the Government of this country learned to take that course the position of the nation at this moment would be incalculably better than it is. When it was suggested to Mr. Gerald Balfour that his Board of Trade electrical staff is not adequate for the duties thrown upon it, he was apparently unable to grasp the meaning of the criticism. What is meant is that, instead of relying upon inspectors who from the nature of the case were not originally the foremost men in electrical engineering, and who, again from the nature of the case, are not the men most abreast of the developments achieved since their appointment, the Board of Trade should be guided by the advice of the real experts and pioneers who are actually doing the things which its official experts can only criticise from their bureaucratically narrow standpoint.

This nation really has no chance in modern conditions unless official persons generally consent to recognise that there are a great many important subjects about which they know nothing, and which are in a state of such rapid change and development that no student, of the calibre which an official salary will attract, can possibly be and remain in a position to legislate about them. What we want is that the real practical and scientific intellect of the country should be called to the aid of the politicians and their official "experts." It is not by Boards of Trade, with their self-sufficiency, their timidity and their necessary ignorance of the later phases of development, that other nations have adapted their legislation to the progress of science. It is by giving intellect that advisory place in the framing of legislation which it will never seek by the politician's method of appealing to the ballot-box. The electrical, chemical, physical and biological questions, upon the solution of which so much modern progress and prosperity depend, deserve and demand the habitual consultation of the best men engaged in their study.

Men of science and leaders of industrial development are familiar with these opinions, and it is time that our statesmen regarded national needs from the same point of view. Unless this is realised the nation cannot hold its position in the industrial wars of the world. The Duke of Devonshire's Commission many years ago gave a warning that continued neglect of scientific and technical interests by the Government must lead to disaster, and we have persistently called for reform to prevent the loss that must come unless the views of our

political leaders undergo a complete change. If the awakening does not come soon, the task of making up for the years of forced inaction will be almost impossible to accomplish.

From what has been said it will be seen that no definite hope can be given of an immediately beneficial result accruing from the deputation. It serves, however, to bring the matter somewhat prominently to the notice of the Government and of the general public, and if it accomplishes nothing more it will in this have paved the way for future reform. It is desirable that the public should be educated to know the advantages which electrical engineers are ready and anxious to confer upon them, and why it is that these have not yet been bestowed. Thirteen years ago Prof. Ayrton, in his oft-quoted Sheffield address, predicted that a time was coming when the Sheffield grinder would work amidst beautiful surroundings, deriving the power he needed from a small electrically driven motor. The time is now ripe for the realisation of that prophecy; in some few places, indeed, it is already begun, but for its free and rapid development there are many abuses and much restrictive legislation which must be removed. For electrical distribution the days of the small station supplying a limited area are numbered, and with them the days of effective municipal control. So also with electric traction; wide-spreading tramways connecting town with town and running far out into the country districts are needed to bring about decentralisation and to help to solve the pressing problem of overcrowding. We can hardly expect the municipalities to effect these changes; the arbitrary boundaries of the areas they control have no reference to the suitability of these areas as units for electrical distribution, and their interests are, moreover, to a certain degree directly opposed to decentralisation. Thus, quite apart from any considerations of the purity of the management or efficiency of municipal electrical undertakings, it will be seen that there is good reason in many cases for looking for better results to the nation from company working. In the train of developments such as would follow the removal of restrictive legislation, we may hope to find the improvement of our position as manufacturers of electrical machinery. The country lacks neither opportunities nor electrical engineers capable of making use of them. We may therefore reasonably look to the development of electrical undertakings to confer a double benefit upon the country; directly, by increasing the comfort and health of the people, and by facilitating commercial work of all kinds; and indirectly by increasing the number and size of electrical factories, and so contributing to the wealth and prosperity of the nation and helping it in the struggle with foreign competitors.

REPORT ON THE TEACHING OF GEOMETRY.

THE immediate result of Prof. Perry's Glasgow address has been the appointment of two committees, the work of which is now near to completion. The British Association committee has, we believe, concerned itself with the more general aspects of the problem. The committee of the Mathematical Association, largely composed of schoolmasters, is formulating a set of detailed recommendations, of which the geometry section was published in the May number of the *Mathematical Gazette* (George Bell and Sons).

The Mathematical Association committee contains delegates from the chief public schools within easy reach of London; it has, therefore, something of a representative character. Its recommendations are very definite; as the editor of the *Gazette* remarks, "it is very desirable that mathematical masters and others should fully avail themselves of this opportunity of placing on record their views as to the proposed changes." The secretary of the committee, Mr. A. W. Siddons, Harrow School, Middlesex, will be glad to receive criticisms of the report.

The study of formal geometry is to be preceded by a substantial introductory course, in which the subject-matter of geometry is to be treated experimentally and inductively. The pupil is to be carefully trained in the use of simple mathematical instruments; he is to be allowed to convince himself of the truth of geometrical theorems by numerical measurements and calculations. In this way he will make his first acquaintance with the main facts of geometry. When he has thus gained familiarity with the subject-matter, he will be in a position to apply the machinery of logic to his knowledge; he will be able to enter, with his eyes open, upon the task of consolidating into a consistent whole the facts he knows. Throughout his whole course he is to treat problems of construction in a practical way; he is not to be content with describing how the thing is done, he is to do it.

Passing to the formal study of geometry, Euclid, or rather a skeleton Euclid, is to be retained as a framework. Large omissions are recommended, but the logical order is to stand.

Theorems are cut loose from the limitations of construction by the admission of "hypothetical constructions." For example, the *pons asinorum* may be proved by bisecting the vertical angle, and thus dividing the isosceles triangle into two triangles that can be shown to be congruent by Prop. 4. For it is obvious that an angle has a bisector, even though the method of constructing it with ruler and compass may appear later in Euclid; the bisector might be found equally well by folding the triangle in two.

Constructions are to be taken out of the formal course and treated in whatever order seems advisable. It is clearly absurd to keep to Euclid's order of constructions unless we are confined to the use of his instruments, an ungraduated ruler and a pair of compasses that cannot be trusted to transfer a distance.

The following order is recommended in teaching the *theorems* of the first three books:—Book i., Book iii. to 32 inclusive, Book ii., Book iii. 35 to the end.

The course is to be lightened by the omission of a considerable number of dull and obvious propositions, such propositions being found more especially in Book iii. Definitions are not to be taught *en bloc* at the beginning of each book, but are to make their appearance only when needed.

It is suggested that two locus propositions should be added to Book i.—the locus of points equidistant from two points, and the locus of points equidistant from two lines. This will enable the pupil to inscribe and circumscribe circles to triangles at an early stage.

Playfair's axiom is preferred to Euclid's; and illustration by rotation is recommended in dealing with angles connected with parallel lines, triangles and polygons.

After Book i. we are to pass to Book iii., which by the omission of Props. 2, 4, 5, 6, 10, 11, 12, 13, 18, 19, 23, 24 is reduced to very modest dimensions. To cover the ground of the omitted propositions there is to be a preliminary discussion of the symmetry of the circle about a diameter, which can be managed experimentally by folding the circle and pricking holes round the semi-circumference.

The "limit" definition of the tangent is allowed; and Euclid's three propositions 16, 18, 19 are condensed into one—"The tangent at any point of a circle, and the radius to the point of contact are at right angles to one another."

Book ii. is to be illustrated by algebra; and in order to simplify the geometrical proofs a rectangle is to be defined as a parallelogram with one of its angles a right angle. The use of the signs + and − is sanctioned.

For Book iv. we find the proposal "that all propositions be omitted, as formal propositions, except 2, 3, 4, 5, 10, and that these be taken with earlier books, the rest of the book being treated as exercises in geometrical drawing."

Coming to Book vi., it is recommended "that an ordinary school course should not be required to include incommensurables; in other words, that in such a course all magnitudes of the same kind be treated as commensurable." This at once relieves teachers from an enormous task—that of explaining Euclid's definition of proportion. There is now nothing to be said beyond that the ratio of a to b is the fraction a/b. To meet this change, two alternative proofs are given for vi. 1, though attention is called to the continental practice of making the proof of vi. 2 self-supporting.

With regard to areas, the tendency of the report is to make the treatment algebraic. Euclid vi. 14, 15, 16, 17, 23 contain merely the one fact that the area of a parallelogram is $ab \sin\theta$; nothing is gained by concealing this fact from the student. It is definitely suggested that "numerical" trigonometry shall be taught concurrently with Book vi. "In connection with the formal course, as soon as the proposition that equiangular triangles are similar has been proved, the sine, cosine and tangent can be defined (if this has not been done earlier in the experimental course). In order to make the meanings and importance of these functions sink deeply into the pupil's mind, numerical examples should be given on right-angled triangles (heights and distances); these should be worked with the help of four-figure tables."

"In accordance with the spirit of the above proposals, the committee suggest that the following proposition be adopted:—If two triangles (or parallelograms) have one angle of the one equal to one angle of the other, their areas are proportional to the areas of the rectangles contained by the sides about the equal angles."

"All statements of ratio may be made in fractional form, and the sign = used instead of the :: sign. In the ordinary school course reciprocal proportion should be dropped, and compounding replaced by multiplying."

The report may be described as an attempt, on conservative lines, to simplify the study of geometry and to make it interesting. If the attempt is judged to be successful, now is the time to make examiners unstop their ears. C. G.

SEISMIC FREQUENCY IN JAPAN.

IN no country has seismology been more carefully nurtured than in Japan. At the University we find a professor and assistant professor of this branch of science; in the Meteorological Department there is a bureau controlling more than 1000 observing stations, and, lastly, there is a committee composed of engineers, architects and men of science who, as an aid to carrying on investigations which will lead to a better understanding of earthquake phenomena, are supported by a Government grant.

This body, since its establishment eleven years ago, has already published thirty-six quarto volumes in Japanese and eight in English, and it is to the last of these, by Dr. F. Omori, professor of seismology, to which we now refer. Unlike many of the volumes by which it is preceded, which treat of construction to resist earthquake effects and kindred branches of applied seismology, this particular publication deals with questions which are purely scientific. Its title is "Annual and Diurnal Variations of Seismic Frequency in Japan," the investigation of other periodicities being left for a future occasion.

The materials analysed are 18,279 entries contained in earthquake registers from twenty-six meteorological stations which are distributed in a fairly uniform manner over the Japanese Empire. These registers, which for the most part are dependent on instrumental observation, are discussed separately, and it is in consequence of this method of treatment that conclusions new to seismology have been reached.

The first out of a series of seventy-six curves shows the monthly frequency of earthquakes in Tokio. In plotting this, as in plotting curves for other stations, those months where the ordinary seismic frequency has been affected by "after shocks" have been omitted; that is to say, the curves represent the normal frequencies in various districts. These omissions, all of which refer to the settlements which follow destructive earthquakes, are carefully epitomised. Dotted curves drawn through the mean position of monthly curves show annual and semi-annual periods. A comparison of the curves for seasonal seismic frequency shows that these may practically be divided into two groups. In one group the maximum frequency is in winter, whilst in the other group the maximum frequency is in summer. When we turn to the geographical distribution of the stations the records from which give these curves, it is found that they are distributed over two distinct areas—those which show a winter frequency lie in a district chiefly shaken by earthquakes having an inland origin, whilst those where the greater number of disturbances are noted in summer occupy an area shaken by earthquakes having a suboceanic origin.

In an endeavour to explain this striking result, the annual, monthly and diurnal frequencies are compared with corresponding fluctuations in barometric pressure. The general result arrived at is that the curves showing the winter frequency follow those of changes in barometric pressure, from which it may be inferred that an increase in barometric pressure has a marked effect upon the yielding of a land area. With the curves relating to earthquakes of suboceanic origin, it is seen that the annual variation is the reverse of the barometric pressure on land.

With regard to diurnal variation in seismic frequency, Dr. Omori concludes that this is probably due to corresponding variations in atmospheric pressure, but such frequency is not confined to earthquakes originating on the land. Single barometric fluctuations, even if they amount to 20 mm., are not generally related to any marked increase in seismic frequency.

Although the last two observations apparently contradict the more important result indicating a relationship between fluctuations in barometric pressure and the seasonal frequencies of earthquakes originating beneath the sea and on the land, arguments are adduced to show how such contradictions may be harmonised.

The distinction in the rules which governs the frequency of earthquakes with these distinctive origins, now brought forward for the first time, may probably be emphasised when, rather than analysing the registers from different stations—the entries in which may frequently be common to a number of such stations—an analysis is made of registers of earthquakes classified according to their origins. As illustrative of such materials we may refer to a catalogue of about 9000 shocks, published as vol. iv. of the *Seismological Journal of Japan*, in which each entry is referred to a district from which the shock it represents may have originated.

In conclusion, not only do we congratulate Dr. Omori on this new departure in seismology, but we also congratulate the Earthquake Investigation Committee on the admirable manner in which it has presented its results to those outside the pale of eastern ideography.

J. MILNE.

THE WEST INDIAN VOLCANIC ERUPTIONS.

A FEW additional notes referring to the recent volcanic eruptions in the West Indies have been received during the past week. Sir W. T. Thiselton-Dyer has sent us an extract from a letter written on May 29 by Dr. Nicholls, C.M.G., of Dominica, and as it contains testimony from one of the leading scientific men in the West Indies, the statements it contains are of exceptional value.

Dr. Nicholls remarks that the volcanic phenomena in both islands were somewhat similar, but in the ejecta from the volcanic vents there were differences. Thus the lava (and its products, viz. pumice, scoriæ, mud, ash and dust) thrown up from Mont Pelée was of an andesitic nature, whilst from the St. Vincent volcano a light basaltic lava was ejected.

Evidence of the hot blast which accompanied the eruption has already been given. One of Dr. Nicholls's friends was a passenger in the s.s. *Roddam*. "When the red-hot hurricane struck the ship he was enveloped in flames, as his clothes were set alight, and in his agony he jumped into the sea, which was almost boiling, and was not seen again." As to the cause of this extremely high temperature and the instantaneous destruction of life at St. Pierre, Dr. Nicholls says :—

> The eruption came suddenly and unexpectedly, and probably in a few minutes the 35,000 persons in the city of St. Pierre were corpses. It would appear that a sudden fissure was opened on the side of the mountain overlooking the city, and near to the Etang Sec on this flank of the volcano a large vent belched out lava, superheated steam and acid gases downwards on to St. Pierre and the roadstead. The flashing off into steam of the water imprisoned in the incandescent lava converted that lava into sand and dust before it reached the city, and the radiation of heat from molten rock at a temperature of above 1000° C. caused an incredibly hot blast that would create a red-hot hurricane—if I may employ such a term—that would kill people and animals instantly and that would cause all inflammable matter to burst into flame. This, from what I gather, is what really happened, and I do not think that poisonous gases or electrical phenomena are accountable for the destruction of life. You can imagine what is the enormous heat right over the vent of an active volcano. Well, St. Pierre practically for a short time was in such a position, the vent being directed laterally towards the city until the fissure was closed and the volcanic ejecta were again directed vertically upwards. Many persons were actually burnt in places by hot scoriæ and mud, but the blast of heat from the volcanic vent appears to me to account in the only satisfactory way for the details I have obtained of the conditions found in the living and the dead.

In connection with the eruptions, it is of interest to learn from the Meteorological Office pilot chart of the North Atlantic and Mediterranean for June that a year ago a report was received from Mr. Francis Watts, of the Government Laboratory, Antigua, showing that on May 5, 1901, the schooner *Kate*, from Barbados to Antigua, ran into a violent commotion of the sea 32 miles eastward of the south end of Martinique. There was no wind, and it was concluded that the phenomenon, which lasted four hours, was caused by a submarine eruption. The report is recalled as possibly bearing upon an early indication of the activity which culminated in the recent disasters. At 6 p.m. on May 9 last, Captain Hernaman, of the Royal Mail Steamer *La Plata*, when 100 miles westward of St. Lucia, observed a green coloured sunset, and at midnight dust was falling on board. At 10.30 p.m. on the same date, the ship *Anaurus* experienced a severe submarine earthquake in 4° 38′ N., 32° 28′ W., the sea being violently agitated, the shock lasting 30 seconds.

The *Daily Mail* correspondent at St. Lucia says it is certain that there have been some changes on the sea floor in connection with the eruptions. He adds :—

> The colonel commanding the Royal Artillery and the colonel commanding the Royal Engineers at St. Lucia both saw an eruption in the sea off that island, the water being shot up into the air, accompanied by rumblings. This occurred two days in succession, and was noted by independent eye-witnesses.
>
> Also, at Grenada, in the little harbour, near the Botanical Gardens, the water bubbled up as in a cauldron and rumblings were heard, but at Dominica all was quiet.
>
> I may mention that when the *Pallas* was at Chateau-Belair on May 21, with Sir Robert Llewelyn on board, I noticed a bubbling in the harbour just twenty yards astern of us, but it was so slight I thought it probably a vent in the bottom of the sea letting off steam, but I called the attention of others to it.

Prof. Bonney exhibited a mounted specimen of volcanic dust from Mont Pelée at the meeting of the Geological Society on June 11. Notwithstanding the risk of generalising from a single slide, he expressed the belief that the ejecta of the Soufrière and Mont Pelée are generally similar. Both, compared with specimens from Cotopaxi, are more uniform in size. The travelled dust from the Soufrière is a little smaller than that from the actual summit of the Andean volcano, but coarser than similar material from Chillo (more than 20 miles), Quito (35 miles), Ambato (45 miles), Riobamba (65 miles), and the summit of Chimborazo, about the same. All these vary much more in size and run distinctly smaller, especially the last. That from Mattakava, Hick's Bay, New Zealand (which fell on June 16, 1886), is rather coarser, more scoriaceous, with fewer mineral-fragments (especially of pyroxene), to which a dirty glass is often adherent. The dust from Barbados, ejected by the St. Vincent Soufrière in 1812, is very much finer-grained, but contains the same minerals, though pyroxene is less abundant.

The St. Lucia Weather Report for May states that, from the 15th to the 20th, the whole island was enveloped in a light hazy mist, the result of volcanic ash suspended in the air. Traces of this ash could be seen on all foliage, it being apparently deposited more freely at night.

The harbour master at Bridgetown, Barbados, has collected from captains of ships information relating to falls of volcanic dust encountered at sea, and the following reports thus obtained appear in the *Agricultural News* of June 7 :—

May 7, 8 p.m., schooner *Violo*, from Demerara, met the dust 70 miles S. of Barbados. 10 p.m., the Norwegian steamer *Talisman*, from Demerara, 150 miles S.S.E.

May 8, 2.30 a.m., barque *Jupiter*, from Cape Town, 830 miles E.S.E. Hour not stated, barquentine *Fanny*, from Pernambuco, 250 miles E.

May 9 (?8), 4 p.m., ship *Monrovia*, from Rio Janeiro, 240 miles S.E.

(Bearing and distance in each case from Barbados.)

It is to be hoped that all the captains collected samples of the dust, and that these will be available for analysis, as it is desirable to ascertain the characteristics of the ash according to the distance of its descent from the crater from which it was ejected, the coarser particles presumably descending at the shortest distances, the finer at the furthest.

Drs. Fleet and Anderson, the Royal Society's Scientific Commission to investigate the outbursts, were due at Barbados on June 9. The Secretary of State for the Colonies had cabled to Dr. Morris, the Imperial Commissioner, to meet them on their arrival.

Reports have been published of additional volcanic and seismic disturbances which have occurred during the past few days. A telegram from Martinique on June 19 states that a column of mud has been ejected by Mont Pelée and has fallen on Basse Pointe, destroying a number of houses and flooding the lower part of the village.

A message received at Calcutta on June 19 reports that an earthquake has shaken the whole ridge of the Himalayas from Simla to Chitral. The shock was not very violent, but nothing so extensive has been known before.

We have also to record that a violent earthquake occurred at Cassano Al Jonio (Calabria) in the morning of June 22, accompanied by subterranean rumblings. The population was terrified, but no damage was done.

THE ROYAL SOCIETY SOIREE.

A BRILLIANT company of ladies and gentlemen was present at the Royal Society conversazione last week. Many of the exhibits were the same as on the occasion of the previous conversazione on May 14 (see p. 83), but there were some others in addition, and these are briefly mentioned below.

Dr. Morris W. Travers showed apparatus for liquefying hydrogen. Hydrogen, when compressed at the ordinary temperature and allowed to expand, becomes warmer, while air under the same conditions becomes colder; at temperatures below −80° C., hydrogen becomes an imperfect gas, in the same sense as air, and undergoes cooling on free expansion (Joule-Kelvin effect). The gas, under a pressure of 120–150 atmospheres, passes through coils in the interior of the apparatus, which are cooled in solid carbonic acid and alcohol (−78°·5 C.), in liquid air (−185° C.), and in liquid air boiling under reduced pressure (−200° C.). It then enters a regenerator coil, and expanding at a valve at the bottom is partially liquefied. The liquid collects in a vacuum-vessel at the bottom of the apparatus; the unliquefied gas passes upwards through the regenerator coil, cooling the gas it contains, and returns to the compressor.

Apparatus for obtaining serial sections of fossils, and restorations of fossils in wax built up from serial sections, were shown by Prof. Sollas, F.R.S.

Prof. F. W. Oliver exhibited Stephanospermum and other fossil Gymnosperm seeds. All the seeds exhibited were from the permo-Carboniferous of Grand' Croix, near St. Étienne. They were preserved in silica, and showed remarkable preservation of detail. The majority of the sections were of *Stephanospermum akenioides*, the seed in which a pollen-chamber was first discovered by Brongniart in 1875.

Photographs of the Rocky Mountains of Canada, and objects collected, were shown by Mr. Edward Whymper.

The Silchester Excavation Fund Committee exhibited a series of objects illustrative of recent discoveries on the site of the Romano-British city of Silchester, near Reading.

Examples of telephotography in the Alps and Himalayas were exhibited by Prof. E. J. Garwood.

Dr. F. W. Gamble and Mr. Frederick Keeble had an exhibit designed to show the chromatophores and colour-changes of Crustacea.

Mr. W. Gowland showed Japanese pictures of Buddhist divinities and saints by old masters.

Mrs. E. Walter Maunder exhibited drawings from two photographs of the corona of 1901, May 18, taken at the Royal Alfred Observatory, Mauritius.

A series of photographs illustrative of old customs still extant in Hungerford, Knutsford and Corby was shown by Sir J. Benjamin Stone, M.P.

An attempt to reproduce an Aurora Borealis was shown by Prof. W. Ramsay, F.R.S. The spectrum of the Aurora Borealis has been shown to contain lines due to the pressure of krypton; the great majority of the lines, if not all, are coincident with those of the krypton spark spectrum. An electrode-less discharge in air gives a spectrum in which the leading green line of krypton, 5570·5, is distinctly visible at low pressures. This discharge can be deflected by a magnet, sending out streamers in the lines of magnetic force. The main phenomena of the Aurora are thus reproduced.

A model of the exploring vessel *Discovery* was shown by the Joint Antarctic Committee of the Royal Society and Royal Geographical Society.

Prof. H. L. Callendar, F.R.S., had on view (1) simple apparatus for determining the mechanical equivalent of heat, and (2) vacuum-jacket calorimeters.

Mr. Edwin Edser and Mr. Edgar Senior showed an experiment illustrating a paradoxical consequence of the wave theory of light. Light enters a glass prism, of which the angles are equal to 90°, 45° and 45°, by one of the mutually rectangular faces, the angle of incidence being equal to zero. It is then reflected from the hypotenuse face at an angle of 45°, which exceeds the critical angle. A photographic grating (3000 lines to the inch) is formed on the hypotenuse face, the rulings being parallel to the axis of the prism. The secondary wavelets which, according to the wave theory, are formed at the clear spaces, produce diffraction spectra, of which the first five or six are visible. If the grating were absent, no light could leave the hypotenuse face of the prism. Thus, light which cannot penetrate the face when the latter is clear is freely transmitted when parts of the face are rendered opaque.

The "Grubb" collimating telescope gun sight was shown by Sir Howard Grubb, F.R.S.

The West Indian Volcanoes Committee of the Royal Society exhibited specimens and photographs illustrating the fall of volcanic dust at Barbados on May 7 and 8. The principal constituents of the dust are magnetite, hypersthene, augite, plagioclase (anorthite-labradorite), small pellets of pumice, and fine powder composed of minute mineral particles and disintegrated pumice. On heating the dust to about 1200° C., the pumiceous constituent fuses, and the mass on cooling forms a vesicular rock allied to hypersthene-andesite, but exceptionally rich in crystals. (1) Microscopic slides are shown illustrating the composition of the dust:—(*a*) dust as it fell; (*b*) magnetite; (*c*) hypersthene and augite; (*d*) plagioclase; (*e*) pellets of pumice; (*f*) thin section of partially fused mass. (2) Photographs of vegetation covered by volcanic dust, taken at Barbados on May 8, by Mr. W. J. Freeman. The specimens were forwarded by Dr. Morris, of the Imperial Agricultural Department of the West Indies, to Prof. Judd, C.B., F.R.S. The charts were lent by the hydrographer of the Admiralty.

Specimens of volcanic dust from the West Indies were also shown by Mr. Henry Crookes.

Mr. E. J. Bles exhibited living tadpoles of the Cape clawed frog, *Xenopus laevis*, Daud. The remarkable transparency allows the course of the nerves, blood-vessels, muscles, &c., of the head to be easily studied in the living animal. A method of feeding, not hitherto described in the Amphibia, can be watched. Bred from specimens kept in Cambridge for more than five years.

A series of specimens illustrating the life-history of the *Trypanosoma Brucii* was shown by Mr. H. G. Plimmer. This organism is the cause of nagana, or the tsetse-fly disease in South Africa.

Colonel Bruce, F.R.S., and Mr. H. G. Plimmer, exhibited *Apiosoma bigeminum*, the parasite found in the blood of Texas fever of cattle.

New species of fairy flies (Mymaridæ) were shown by Mr. F. Enock. The species are all ovivorous, some laying their eggs in those of the water demons (Dytiscus); as many as seventy-two larvæ of one species have been found in *one* egg of *D. marginalis*. Living specimens, *in situ*, and possibly some emerging.

The Royal Society exhibited a bronze example of the newly founded David Edward Hughes medal, and a medallion of the reverse.

Dr. A. Dendy had on view specimens, sketches and photographs of Moriori workmanship from the Chatham Islands.

A series of otoliths, chiefly of living British fishes, both marine and freshwater, showing the various forms assumed in the different genera, was shown by Mr. E. T. Newton, F.R.S.

Prof. W. M. Flinders Petrie, F.R.S., exhibited a series of worked flints from Egypt.

Experiments exhibiting interference between portions of light from independent sources were shown by Dr. G. Johnstone Stoney, F.R.S.

During the evening, demonstrations, with the help of the electric lantern, were given by Prof. W. M. Flinders Petrie, F.R.S., on early civilisation in Egypt; Mr. J. Y. Buchanan, F.R.S., a series of lantern slides illustrating the performance of M. Santos Dumont's steerable balloon and the accident to it on February 14; and Prof. E. B. Poulton, F.R.S., on recent work upon protective resemblance and mimicry in insects, illustrated by three-colour slides.

NOTES.

A MEMORIAL edition of the scientific writings of the late Prof. G. F. FitzGerald, F.R.S., will shortly be published in the Dublin University Press series. The volume has been prepared under the editorial supervision of Dr. J. Larmor, F.R.S., and footnotes in elucidation or correction of the text have been added where necessary. It extends to about 570 octavo pages, together with 64 pages of an introduction, in part biographical and in part historical and explanatory, of Prof. FitzGerald's relation to contemporary science. As much of his stimulating and suggestive thought was published in journals not readily accessible, just as it flowed from his pen, this substantial collection of papers will in the main be fresh to physicists. Being a record of the activity of a mind that was always in the van of progress, it will also be of interest as a reminder of the paths of advance of physical science during the last quarter of a century.

IT is beginning to be recognised that scientific knowledge, and a progressive frame of mind are attributes which must be possessed by all who are preparing for the struggle of the future, whether in peace or war. In the debate upon the Navy Estimates in the House of Commons on Friday, the scientific aspect of the problem of naval warfare was mentioned, and we are glad to see that Mr. Arnold Forster referred to the importance of keeping it in mind. As to the part science ought to play, and the respect it ought to receive in the Navy, he remarked that he believed it to be true of the Navy, as of every large department, that we had not yet fully realised the position that science had taken, and was bound to take to a still larger extent, in this country and in the world. He did not know that that was peculiar to the Navy. He thought it was far less true of the Navy than it was of many other great departments of life.

AT the general meeting of the Zoological Society of London held on June 19, the gold medal of the Society was delivered by His Grace the Duke of Bedford, K.G., president, to Sir Harry Johnston, G.C.M.G., K.C.B., in consideration of his great services to zoological science while occupying various official posts in Africa and especially in commemoration of his discovery of the okapi. After the close of the meeting, the third of the series of zoological lectures for the present year was delivered by Prof. E. Ray Lankester, F.R.S., on the okapi and its position in the natural series. Prof. Lankester's memoir in the Society's *Transactions*, which contains a full account of all that is known of "the new African mammal" up to the present date, is expected to be ready very shortly.

THE annual general meeting of the Röntgen Society will be held on Thursday, July 3.

IN connection with the Egypt Exploration Fund, an exhibition of antiquities found by Prof. Petrie at Abydos, and by Dr. B. P. Grenfell and Dr. A. S. Hunt in the Fayum and El Hibeh, will be on view at University College from July 1 to July 26.

THE annual conversazione of the Institution of Electrical Engineers will be held at the Natural History Museum, South Kensington, on July 1. There will be a reception of the foreign delegates to the International Tramways and Light Railways Congress at 9.15 p.m.

SINCE May 3, 1832, when Louis Bonaparte, then President of the French Republic, decreed that the Pantheon was again to be considered a Roman Catholic Church, the great pendulum installed by Léon Foucault to afford a proof of the rotation of the earth has been laid aside. M. de Fonvielle informs us that workmen are now busy making preparation for a new series of demonstrations. The operations will be conducted under the supervision of M. Berget, assistant to M. Poincaré. The pendulum itself is a ball of lead weighing 27 kilogrammes, and was used in 1869 by M. Maumenée for observations in the cathedral of Rheims during several months. The new demonstrations at Paris will be given in a few days.

THE United States Senate has passed a Bill directing the President to purchase all the capital stock, concession, unfinished work and machinery, and other property of the Panama Canal Company for 8,000,000*l*. The President is further directed to acquire from the Republic of Colombia a strip of land six miles wide along the route, over which the United States shall have permanent control. The Bill next authorises the completion of the canal. If the Panama Company is unable to give a satisfactory title and Colombia refuses to cede the land, the President is authorised to construct a canal by the Nicaragua route. The *Daily Mail* states that since the Martinique disaster the supporters of the Panama Canal have persistently declared that the Nicaragua route passed through a volcanic country, and that the canal would be liable at any moment to be destroyed. This argument had a marked influence in gaining votes for Panama. The passage of the Bill does not end the canal controversy. The House of Representatives recently passed a Bill authorising the construction of a Nicaragua Canal, with only two dissenting votes, but it is believed that the Senate's decision in favour of Panama will now be accepted.

MR. F. FINN writes to us from the Indian Museum, Calcutta, with reference to the late Prof. V. Ball's identification of the Catreus of Ælian with the Himalayan monal-pheasant. This identification Mr. Finn regards as erroneous, and he adduces reasons for considering the Honduras wild turkey as the bird in question. Possibly specimens of this bird may have been obtained in Ælian's time by the natives of Hindustan from America by way of China. If, however, this explanation will not hold good, the somewhat startling theory is suggested that the Honduras turkey was once a native of India.

IN the U.S. *Monthly Weather Review* for January and February last, Mr. A. Matthews discusses at considerable length the term "Indian summer," and gives references to, and quotations from, numerous works relating to its use. In America this season is connected both by name and popular belief with the aborigines; but the term is said to date only from about the last decade of the eighteenth century, and has reference to a spell of warm weather occurring in the late autumn. The term appears to have reached Canada in 1821 and this country in 1830. This warm period is frequently referred to in meteorological text-books; Dr. Buchan points out that if easterly winds have largely predominated in autumn, and south-westerly winds begin to prevail at the end of November, or a little later, the weather is likely to continue exceptionally mild. These conditions occur nearly every year, and the beginning of the warm spell is popularly known in this country as St. Martin's summer.

THE *Agricultural News* of the West Indian Agricultural Department adopts a suggestion that Coronation day, should be marked throughout the islands as an arbor day. It points out that this is exactly the right season for planting purposes. In many localities the planting of ornamental shade trees would be of great public benefit, and at the same time add to the comfort and amenities of life in the tropics. Particulars are given as to the methods of planting, suitable trees and palms for the purpose being always obtainable at the Botanic Gardens.

IN connection with the abnormally cold weather which has prevailed over the British Isles, and to a great extent over Western Europe also, since the closing days of April, considerable interest attaches to the temperature of the surface water of the Atlantic during the month of April. The mean results, derived from a total of 4150 observations, are given on the pilot chart for June, just issued by the Meteorological Office. There appears to have been an almost complete absence of ice about the banks of Newfoundland, a fact which is emphasised by the sea water of that region being warmer than usual, the excess ranging upwards to as much as 6° in places. Westward of the thirty-fifth meridian, from 30° to 35° N., the temperature was also rather above the normal, but from the coast of Virginia eastward between these relatively warm patches, along what may be described, roughly, as the Gulf Stream course, there was a deficiency of temperature right across the ocean to our coasts, the eastern half of the Atlantic being below the average. Northward of the fiftieth parallel it would appear that there are no normals available for comparison with the present series, which is unfortunate, as the condition of the sea immediately to the west of our islands, between the Fastnet and Iceland, probably exercises an appreciable influence on our climate. Down to June 16, when the pilot chart went to press, there were still no ice reports of any importance on the banks, the latest being May 8, a piece of ice 4 feet square, one of May 5 relating to bergs stranded on the Newfoundland coast, north of Cape Race. The strait of Belle Isle was clear, but floes were drifting down the Labrador coast, so that steamers could not approach the strait from seaward. Iceland reports show that there has been a good deal of ice off the north-western part of the island.

THE result of an investigation by Mr. Maxwell Hall relative to the mean maximum temperature and the rainfall of Jamaica and sunspot frequency has recently been published officially at Jamaica, and has already been mentioned in these columns (p. 159). The temperature observations, a full account of which he gives in the paper, extend over the years 1881 to 1898, and to eliminate minor irregularities Mr. Hall employs for the yearly value the mean of the year and the means of the year each side of this middle year; thus, to take an example, the value for 1885 is the mean for the three years 1884, 1885 and 1886. The temperature variations found in this manner, when compared with the variation in the spotted area of the sun's surface, bring out a close relationship between these two phenomena. Thus it is observed that the temperature is at a maximum at sunspot minimum and *vice versâ*, and that this variation amounts to about 2° F. With regard to the variation of rainfall as deduced from a discussion of the yearly means of rainfall, Mr. Maxwell Hall has previously shown (NATURE, vol. xlix. p. 399) that up to the year 1887 there was a general resemblance between the sunspot curve and that of rainfall, the maxima and minima of the rainfall variations corresponding approximately with those of the curve representing the sun's spotted area, but there were certain irregularities which suggested that the old view that there was most rain at the maximum and least at the minimum of the eleven-year curve was only approximately true. The further discussion of the rainfall observations up to the year 1899 shows, however, that this apparent law breaks down completely. When in 1889 and 1890 the rainfall curve should have been at a minimum, in reality it showed a subsidiary maximum, while also when at the sunspot maximum of 1893-4 the rainfall should have been excessive, it was conspicuous by a great deficiency.

THE important aid that photography can render to the surveyor has recently been well illustrated by a paper read before the Institution of Mining Engineers by Mr. Arthur O. Wheeler, attached to the staff of the Canadian Topographical Survey. In this paper we have the actual experience of one who has been much engaged in practical surveying, and his notes having reference to the selection of stations and to the photographic processes necessary in the field are as valuable as those which deal with the after manipulation of the photographic enlargements and the production of the contour maps. The application of the photographic method is based on the consideration of the triangle, the angles at the base of which are formed by lines drawn from the two known stations, at which the perspective view of the country has been obtained in the camera, to the point which is to be projected, and which may be considered the apex of the triangle. Accuracy demands that the triangle should be well conditioned, and reaches its highest value when the angle at the apex approaches a right angle. There will be difficulties connected with the selection of suitable stations, difficulties in the identification of orientation points, which Mr. Wheeler makes no attempt to minimise, but a peculiar feature of the method is that it is best adapted to a country where the actual measurement in the field is tedious or impossible. It was pointed out in the discussion of Mr. Wheeler's paper that the method did not offer great advantages in a country of gentle slopes and rounded outlines, with relatively small differences in elevation, because of the uncertainty of locating the points on different photographs. But when the country possesses no inconvenient features, other methods are easy of application. Moreover, it was urged that the plotting of the points is more laborious than in the older methods of surveying. Mechanical devices based on the theory of perspective can do much to shorten the office work of plotting, and in any case this delay and expense are more than compensated by the rapidity of the field work and the employment of a smaller number of assistants required to remove obstacles in an untravelled country. The method has been employed practically in Canada, where the Topographical Survey has been carried into regions the severe climate of which renders it desirable to shorten as far as possible outdoor operations.

A CONVENIENT form of rectifier and interrupter for use with alternating currents is described by Dr. Guilleminot in the *Archives d'Électricité Médicale* for May. The current to be used is led through a vibrating reed, which carries at its free end a contact dipping in and out of a mercury cup. The reed is placed between the poles of a permanent magnet and is magnetised by a coil of wire which surrounds it; the coil is connected (in series with self-induction and resistance) as a shunt to the main circuit. A damping arrangement is also attached to the reed. The reed vibrates in synchronism with the alternating current, and as the contact only dips into the mercury when the reed is deflected downwards, the main circuit is synchronously opened and closed, thus converting the alternating into an intermittent direct current. The great advantage of the apparatus is the ease with which it may be adjusted; the mercury cup can be raised or lowered, thus regulating the time of closed circuit; the length of free reed can be varied, and the phase of the vibration relative to that of the alternating supply can be altered by varying the self-induction in series with the exciting coil. It is thus possible to open the circuit always at the most suitable point of the wave—which depends, of course, on the purpose for which the current is being used. The apparatus, which is said to give excellent results in X-ray work, is the invention of Prof. Villard, and is made by M. Chabaud.

THE *Zeitschrift für Elektrochemie* for May 8 contains an interesting article by Dr. A. Ludwig upon the fusion of carbon. After referring to Moissan's classical work on this subject, and to the famous French chemist's production of diamonds in the electric furnace, the author gives details of his own work.

Theoretical reasoning had led him to the belief that, working under sufficient pressure, it would be possible to melt carbon and to maintain it in the liquid condition, and actual experiment verified this theory. At a pressure of 1500 atmospheres, the arc between two carbons inserted in the pressure vessel failed, and not even an E.M.F. of 70 volts sufficed to carry the current across the gap separating them. The author's explanation of this phenomenon is, that the carbon had assumed the third allotropic state, and had in its passage into the liquid and transparent condition become a non-conductor. The difficulty of maintaining it in this condition was, however, great, and in some cases the phenomenon only lasted a few seconds. Attempts were made to obtain diamonds, by sudden cooling of the interior of the pressure vessel by an inrush of water, but although unmistakable diamonds were found amongst the hard grey powder that was obtained, the results were not altogether satisfactory. The apparatus used by the author in these investigations has been patented (English Patent No. 16908, 1900), and as circumstances have compelled him to relinquish his own investigations of the subject, he hopes that others may continue the experiments along the lines he has indicated.

THE development of the large Beaumont oil-field in Texas, which is situated only sixteen miles from the coast, will probably lead to oil being much more largely used as fuel for engines than it has hitherto been. The possibility of a cheaper supply of oil is a matter that is of great importance to this country, and may lead to the increased use of motor cars for suburban traffic and for trade purposes. The oil will be conveyed from the oil-field to the coast by pipe lines, along which the oil will flow by gravity into tank steamers, the cost of conveyance to this country being not much more than a halfpenny a gallon. It has been found by experiment that four and a half barrels of oil, or 189 gallons, are equivalent to one ton of the best coal. Oil is now used largely in America as fuel. On the Southern Pacific Railway 300 engines have been adapted to burn oil, and it is anticipated that a very large sum will, in consequence, be annually saved in the working expenses. In Russia no other fuel than oil is used on the 1600 miles of the Trans-Caspian Railway.

IN the *Proceedings* of the Royal Society of Victoria, of which we have just received part ii. of vol. xiv., 1902, geology dominates, and zoology is the only other science dealt with. The natural history of the country is attracting particular attention, as shown by papers on Crustacea, Polyzoa and Mollusca. Mr. T. S. Hall and Mr. G. B. Pritchard discuss a suggested nomenclature for the marine Tertiary deposits of southern Australia. Local names are always desirable for formations which cannot be expected to correspond in time with the stratigraphical divisions made in distant regions; and the authors are to be commended for using names peculiar to South Australia, despite the fact that they introduce the Werrikooian and Jan Jucian formations. Prof. J. W. Gregory gives an account of the geology of Mount Macedon, an isolated mountain ridge, which though forty miles distant is one of the most conspicuous features in the views from Melbourne. It consists of a volcanic pile resting on Ordovician rocks. The igneous outbursts may have commenced in late Cretaceous times, but there is no certain evidence. The mountain, however, probably marks the beginning of the great period of volcanic activity of which the last eruptions built up still existing craters, and of which records are preserved in the legends of the Victorian aborigines.

THE *Journal* of the Franklin Institute (vol. cliii. No. 1) contains an account of the half-tone trichromatic process of colour-printing, by Mr. F. E. Ives. Until recently, all the finest colour-printing has been done by the chromolithographic process employing from seven to twenty stones with as many inks and impressions. It has long been thought that, in accordance with the trichromatic theory of colour vision, three printing surfaces, colours and impressions might be substituted for the seven to twenty of the lithographer, and that the preparation of these surfaces might be accomplished photographically. The only commercially successful development of this idea at the present time is by the employment of three half-tone process blocks made from a trichromatic negative colour record and printed with three coloured inks in the type process. Up to the present the quality of the product of this process has, however, been so uncertain that the process has been brought somewhat into disrepute. The author shows that conditions can be secured which make it possible to obtain the best results almost automatically.

IN the *Scientific Transactions* of the Royal Dublin Society (vol. vii.) is a paper by Prof. Joly on sedimentation experiments and theories. The rates of settlement of suspensions from solutions containing ions in various degrees of concentration indicate that above a certain concentration the rate of fall of the surface of the suspension is fairly independent of the degree of concentration. Below certain concentrations a distinct surface to the descending suspension fails, and the sediment is only seen to collect from the bottom of the vessel upwards. A suspension precipitated at a concentration in the neighbourhood of this critical concentration does not again precipitate with a distinct surface if reshaken. On removing the electrolyte from such an "exhausted" suspension, it is found that the liquid is as effective as at first in producing surface if a fresh sample of the powder is used. On the other hand, the original powder will not again exhibit the formation of surface when treated with fresh electrolyte of the same strength, but requires a more concentrated solution to do so. The failure is, therefore, to be traced to some alteration in the solid particles, and on testing the fresh powder it is found to be electrically negative towards distilled water, whereas the used powder is neutral or nearly so towards its salt solution. The author advances a theory of the process of sedimentation to account for the observed phenomena.

"THE Pioneers of Evolution, from Thales to Huxley," is the title of a pamphlet of 114 pages by Mr. E. Clodd, published for the Rationalist Press Association by Messrs. Watts and Co.

THE Agricultural Department of the Cape of Good Hope has issued a catalogue of South African fishes (marine and freshwater), drawn up by Dr. J. D. F. Gilchrist, the Government biologist.

IN his report of the Ghizeh Zoological Garden for 1901, Captain Stanley Flower announces that two important additions have been made to the buildings, namely, the lion-house and the elephant-house, both of which were completed during the year.

IN the June number of the *Zoologist* Mr. R. Service alludes to the change which appears to have taken place of late years in the habits of the black-headed gull, this bird being much more of a land-dweller than formerly.

WE have received a copy of a reprint of an article from *Chambers's Journal* in which Mr. H. F. Witherby recapitulates the main facts connected with the migration of birds, adding a few observations made during his own travels in the eastern Sudan and elsewhere.

A SUPPLEMENT to the *Oxford University Gazette*, issued June 17, contains the report of the delegates of the museum for 1901. Among the more important additions to the collections is a "totem-post," about 36 feet in height, from Queen Charlotte Island, presented by Prof. E. B. Tylor. The Hope professor of zoology announces that the insect collection has

been very largely increased during the year, the most notable item being a consignment of specimens from Sarawak, presented by Mr. R. Shelford.

THE results of a redetermination of the atomic weight of uranium by Prof. T. W. Richards and Mr. Merigold are published in a recent number of the *Proceedings* of the American Academy of Arts and Sciences. Of previous determinations the only one worthy of serious consideration is that of Zimmermann, who in 1886 found the value 239·59. Zimmermann's method, based on the preparation of pure UO_2 and its conversion into U_3O_8, appears likely to give too high numbers, owing to the difficulty of obtaining the lower oxide free from occluded gases and also of oxidising it completely. After much preliminary work and a long search for suitable substances, Messrs. Richards and Merigold chose the analysis of uranous bromide as the basis of their method. The preparation of pure uranous bromide and its manipulation present considerable difficulties. Its analysis was effected by first oxidising it to uranyl bromide by means of hydrogen peroxide and then precipitating the bromine by means of silver nitrate. The results showed satisfactory concordance, and led to a conclusion expressed by the authors as follows:—"If oxygen be taken as 16·000 and bromine as 79·955, the atomic weight of uranium appears to be not far from 238·53." It is remarked that, although this number differs by more than a unit from that given by Zimmermann, the percentage difference (0·45) is smaller than many which have often been passed unheeded in the case of elements of smaller atomic weight. It is, however, a noteworthy difference, and the probability seems to be that Zimmermann's number was too high. The paper of Messrs. Richards and Merigold brings to light many interesting facts about the chemistry of uranium.

THE additions to the Zoological Society's Gardens during the past week include a Chacma Baboon (*Cynocephalus porcarius*) from South Africa, presented by Mr. E. G. Williams; a Patas Monkey (*Cercopithecus patas*) from West Africa, presented by the Rev. E. Millar; a Green Monkey (*Cercopithecus callitrichus*) from West Africa, presented by Mr. W. S. Hewitt; a Serval (*Felis serval*) from Africa, presented by Mr. P. Hayton; a Ground Hornbill (*Bucorvus*, sp. inc.) from South Africa, presented by Mr. F. H. O. Wilson; a Senegal Turtle Dove (*Turtur senegalensis*) from West Africa, a White-fronted Dove (*Leptoptila jamaicensis*) from Jamaica, presented by Mr. D. Seth Smith; a Barn Owl (*Strix flammea*) European, presented by Mr. G. Dundas; two West African Pythons (*Python sebae*) from West Africa, presented by Lieut. Lamprey; a Long-nosed Crocodile (*Crocodilus cataphractus*) from West Africa, presented by Capt. Gibson; an Orang-outang (*Simia satyrus*) from Borneo, an Alpine Chamois (*Rupicapra tragus*) from Savoy, a Suricate (*Suricata tetradactyla*), four Cape Crowned Cranes (*Balearica regulorum*) from South Africa, two Grey Ichneumons (*Herpestes griseus*) from India, deposited; a Chimpanzee (*Anthropopithecus troglodytes*) from West Africa, purchased.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES IN JULY:—

July 2. 6h. 27m. to 11h. 22m. Transit of Jupiter's Sat. IV.
2. 14h. 3m. to 14h. 52m. Moon occults δ^3 Tauri (mag. 4·2).
14. Minor planet Vesta in opposition to the sun.
15. Venus. Illuminated disc = 0·807. Mars = 0·979.
15. 10h. Mercury in conjunction with Neptune. Mercury 1° 34′ S.
15. 15h. Mercury at greatest elongation 20° 35′ W.
17. 13h. Saturn in opposition to the sun.
18. 8h. 51m. to 12h. 34m. Transit of Jupiter's Sat. III.
19. Saturn. Outer minor axis of outer ring = 16″·38.
July 19. 10h. 56m. Minimum of Algol (β Persei).
19. 10h. 58m. to 11h. 54m. Moon occults ρ^1 Sagittarii (mag. 3·9).
23. 14h. Mars in conjunction with Neptune. Mars 1° 37′ N.
25. 12h. 9m. to 15h. 51m. Transit of Jupiter's Sat. III.
27. 7h. Venus in conjunction with Neptune. Venus 0° 11′ N.
28. 14h. Venus in conjunction with μ Geminorum. Venus 0° 2′ S.
28–30. Epoch of the Aquarid meteoric shower (radiant 339°–11°).
30. 14h. 46m. to 15h. 28m. Moon occults *m* Tauri (mag. 5·1).
31. 21h. Venus in conjunction with Mars. Venus 1° 18′ S.

THE ANNA BREDIKHINE ASTRONOMICAL PRIZE.—The conditions of this new astronomical prize, founded by Prof. Th. Bredikhine in memory of his wife, are published in *The Observatory* for May. The prize is to be awarded for the most thorough investigations of any large comet, the investigations to be pursued on the lines followed by the donor in his own famous cometary researches.

OCCULTATION OF W LEONIS.—Mr. J. F. Cole, of Cambridge, Mass., writing to *Popular Astronomy* (June, 1902), notes an observed decrease in the magnitude of this variable double about one half-second before its occultation. He suggests that other observers might endeavour to discern the probable change of colour at the next occultation, which takes place at 9h. 21m. (Washington mean time) on July 7, magnitude 5·6, position angle 99°.

A REMARKABLE BOLIDE OBSERVED AT LYONS ON MARCH 19.—A correspondent of the Société Astronomique de France records the appearance of "a magnificent bolide" at 9.10 p.m. on March 19. The observer, who was situated at Lyons, states that the meteor first appeared in the neighbourhood of Arcturus and then travelled eastwards until lost in the haze on the horizon. Form, round; light, yellowish orange; magnitude, brighter than Venus; trail, none; duration, 2 seconds (*Bulletin de la Société Astronomique de France*).

NOTATION OF VARIABLE STARS.—At the suggestion of Mr. A. Stanley Williams, and with the idea of correlating the various notations, a list of eighty-one variables to which different names have been assigned in published lists of variable stars, has been prepared by Mr. H. C. Wilson and published in this month's *Popular Astronomy*.

Of the various systems of notation in vogue, Mr. Wilson favours that used in the *Annuaire*, where the first nine variables discovered in a constellation are named by the last nine letters of the alphabet in their normal sequence; the second nine variables discovered in that constellation are designated in the same way, but the suffix "2" is added to the capital letter, and so on for the third, fourth, &c., sets of nine. Thus the twentieth variable discovered in Sagittarius is catalogued as S^3 Sagittarii. As the author remarks, "This method is capable of indefinite extension without becoming cumbersome; but, unfortunately, it does not have the advantage of priority, nor of adoption by those who are doing the most valuable variable-star work," and he therefore suggests that the double-letter system, as adopted by the Variable Star Committee of the Astronomische Gesellschaft, should be universally used; further, he suggests that the assignment of the notation to individual stars should be left entirely to the Committee, and, for provisional purposes, he advocates the adoption of the notation now used in the *Nachrichten* when naming newly suspected variables, viz. to assign consecutive numbers and to add the year of discovery, *e.g.* 3, 1901.

STUDY OF BRIGHT POINTS AND CURVES.

THE study of "brilliant points and lines" is an application of the principles of geometrical optics which has not hitherto received the amount of consideration which it deserves, when account is taken of (1) the simplicity of the principles involved, (2) the elegance of the results obtained, and (3) the ease with which the subject can be studied experimentally. The writer of the present note has a dim recollection of having worked out in his undergraduate days a tripos rider in which it was required to find the equation of the bright curves seen

when a source of light was reflected from a metal surface covered with regular scratches or corrugations of a given form, but beyond this he does not remember having seen any other bookwork or examples on the same subject. A general investigation of the theory of brilliant points is now given by Mr. W. H. Roever in the *Annals of Mathematics* for April, pp. 113–128.

When a ray of light emanating from a source which we will call P_1 is reflected at any surface, and an eye is placed at another point, P_2, a point of the surface from which the reflected ray travels directly towards the eye appears luminous and is called by Mr. Roever a *brilliant point*. A mathematical investigation also involves the consideration of points from which the reflected ray travels directly away from the eye, and although such points obviously do not correspond to any visible phenomena, it is necessary to consider them under the name of *virtual brilliant points*. If the reflecting surface is a thin wire, a point P_0 will be a brilliant point if the lines P_0P_1 and P_0P_2 make equal angles with the tangent line to the wire at P_0. We thus get the notion of a brilliant point on a *curve*. Taking next a

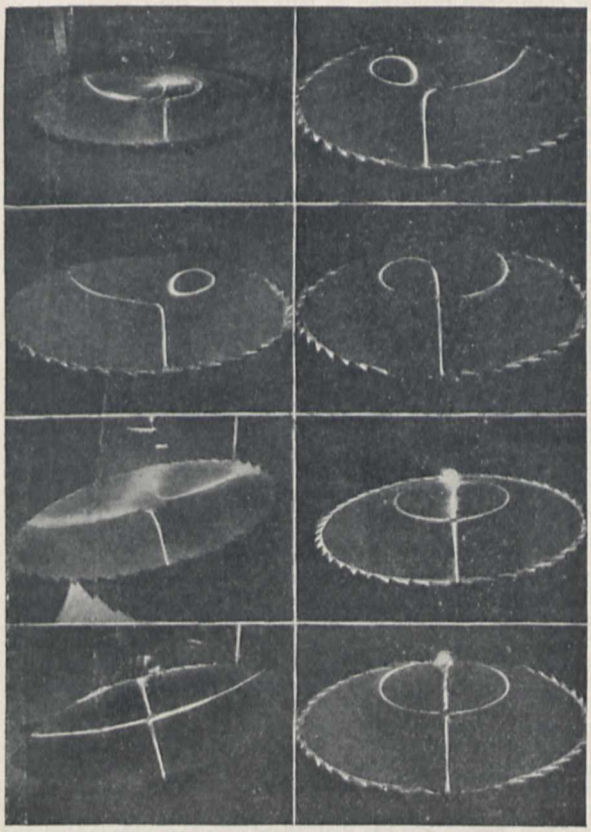

FIG. 1.—Bright lines on a circular saw.

finely but regularly scratched or corrugated surface, the locus of the brilliant points with respect to the curves defined by the scratches or corrugations is the brilliant curve of the system. For a doubly infinite series of curves, the equations of which contain two independent parameters, the mathematical theory leads to the consideration of a brilliant surface as the locus of the brilliant points, although it is not easy to see how this generalisation could be made the subject of experimental verification.

The author, after giving a general investigation, considers the particular cases of the brilliant curve for a circular saw or disc of steel in which the scratches form concentric circles, and also for a rotating carriage wheel in which the curve is generated by the brilliant points of the spokes, *i.e.* of a family of radiating lines in one plane. In both cases the curves are of the fourth degree. The accompanying diagrams are reproductions of photographs of some of the curves obtained with the circular saw. An obvious further example of loci of brilliant points is afforded when moonlight is reflected from waves or ripples on the sea or a lake.

VARIATION—GERMINAL AND ENVIRONMENTAL.[1]

"THE most critical and momentous period in the life-history of any plant or animal," says Prof. Cossar Ewart, "is during the conjugation of the male and female germ-cells." The variation which flows from this blending of the reproductive elements he speaks of as "germinal." That which occurs in the germ-cells up to the moment of conjugation, together with the variations during development and growth, he designates as "environmental."

It may perhaps be questioned in passing whether the distinction is one that can always be observed in practice, and also whether Prof. Ewart's terms are the best that could have been adopted. However, they serve sufficiently well for the purpose of the paper before us.

Some "congenital" characters, he proceeds, may be "acquired"; for example, dwarfing due to embryonic malnutrition. The double uterus of a wild rabbit contained eight young in one division and four in the other, the weight of the two divisions with their contents being nearly equal. In such cases the offspring that has been starved before birth, should it survive, may eventually reach the normal size and produce normal descendants. Antenatal injury, as in constriction by the cord, may lead to "congenital" abnormalities which are neither "inherited" nor transmitted.

Individual plasticity in response to environmental conditions is an obvious and undoubted fact. But can variations so induced be transmitted to descendants? This is still a burning question, in regard to which Prof. Ewart has as yet met with no evidence to support an affirmative answer. On the other hand, the results of his experiments have afforded much reason for the positive belief that the handing on in any form of acquired traits is extremely improbable.

But although there is no evidence of the transmission of somatic characters acquired in virtue of individual plasticity, it is still possible that the general vigour of the somatic tissues may be reflected in the germ plasm, and also that the condition as to ripeness of the generative products may influence the nature of the combinations formed during conjugation. A young Jacobin-barb pigeon mated with an old turbit produced first two young ones which were devoid of all the distinctive points of both parents; but afterwards, on several successive occasions, hatched out offspring which presented points of resemblance with the dam. Prof. Ewart declares that he can only account for this by saying that as the female parent increased in age and vigour her germ-cells increased in prepotency. When she went out of condition, the single offspring then produced more closely resembled the sire.

Some experiments with rabbits led to unexpected results. Several white does were mated with wild males, and several wild does with a white buck. In every case the offspring resembled wild rabbits in form and colour. But the mating of the half-wild offspring with each other, uniform as they were, led to an "epidemic of variation," not only in colour, but also in size, disposition and other qualities. When the half-wild rabbits were crossed with white bucks or does, there were also always several colours represented in the cross-bred litters. An intimate relation was discoverable in all these and their offspring of the next generation between the colour, the "wildness," the time at which maturity was reached, and the rate of growth. Though the half-wild progeny were all wonderfully like wild rabbits, it was evident that in them the stability of the wild rabbit had been broken down.

Further experiments with rabbits—one of which, narrated at length by Prof. Ewart, is of remarkable interest—tend to show that, as in the case of pigeons, the relative maturity of the male and female elements has a definite influence on the character of the offspring. The general results may be summarised as follows:—When insemination precedes ovulation, the young resemble the buck; when it follows, they resemble the doe; when it coincides, some take after the buck, some after the doe, while others may differ from both parents and resemble some of the less remote ancestors. It was incidentally shown that in the rabbit, spermatozoa may retain their potency several days after they reach the fallopian tube. Prof. Ewart notes the

[1] "Variation: Germinal and Environmental." By J. C. Ewart, M.D., F.R.S., Regius Professor of Natural History in the University of Edinburgh. *Scientific Transactions* of Royal Dublin Society, 1901, pp. 353–378. (Williams and Norgate).

correspondence of the foregoing results with those obtained by Vernon in echinoderms.

The difference between different members of the same family must be in part attributed to the potential difference of the cells from which they are respectively developed. Whether the reducing division of the germinal cells is qualitative as well as quantitative is an open question, but there is reason to think that the life-history of these cells previous to conjugation may give opportunity for environmental variation like that of the Protozoa.

Turning now to the subject of "germinal variation," the author points out that the existence of such environmental variation in the germ-cells, apart from reducing division, together with the physiological differences dependent on diverse conditions of vigour and maturity, may be expected in most cases to preclude the new individual from assuming an exactly intermediate position between its parents. When the male and female germ-cells unite, a series of contests takes place between groups of vital units, the issue being decided by their respective qualities, individuality or character.

When different varieties or species are intercrossed, the effects may differ not only in degree but also in kind from those of ordinary cross-fertilisation. The following are some of the results that have been obtained experimentally from such intercrossing :—

(1) The offspring may be almost exactly intermediate between the parents.

(2) The offspring may resemble one of the parents and not the other. This is often the case when wild animals are crossed with tame varieties of the same species. (It must, however, be remembered that the resemblance may be only superficial, as was clearly the case in the experiments with half-wild rabbits cited above.)

(3) Some of the offspring may resemble one parent, some the other. (This seems especially likely to occur if one or both of the parents is a sport. Standfuss's results with insects are in accord with this.)

(4) The offspring may combine, almost unimpaired, the more striking characters of both breeds. This has been seen in both pigeons and rabbits.

(5) New or unexpected characters may appear in the progeny. Three out of four of a litter of cross-bred rabbits developed a habit of "spinning."

(6) When half-breeds are crossed, the offspring tend to be extremely variable. Evidence of this is plentiful both in animals and plants.

(7) Sometimes the offspring, instead of resembling the parents, resemble former ancestors. Prof. Ewart mated a cross between an "archangel" and an "owl" pigeon with a white fantail. The issue was a bird with a striking resemblance to the ancestral "blue-rock." (Analogous results have been several times obtained in the case of insects.)

Prof. Ewart's paper is interesting and suggestive to a high degree. It would be hard to overestimate the value of the experiments which he is conducting with so much care and judgment in his well-selected menagerie at Penycuik.

F. A. D.

RUST-FUNGUS.

PROF. MARSHALL WARD'S investigations into the relations between host and parasite in the case of the Brome-grasses and their rust-fungus are bringing to light some interesting facts which have important bearings on the long-vexed questions of wheat-rust and the rust problem generally, which, as is now well known, have passed into an acute stage of late, principally owing to Eriksson's enunciation of his belief that the fungus can be transmitted in an invisible form *viâ* the seed.

In addition to testing this mycoplasm hypothesis of Eriksson's, the researches undertaken by Prof. Marshall Ward are also directed to put to the proof the questions of degrees of specialised parasitism raised during the last decade by the researches of Plowright, Kleebahn, Eriksson, Magnus, Fischer, and others, and more especially, to see if any deeper insight can be obtained into the causes of epidemics and the relative predisposition or immunity of certain plants to attack.

In a paper read to the Cambridge Philosophical Society on January 20, 1902, Prof. Ward gave a summary of his results with more than eighteen hundred infection experiments, made on twenty-two species and varieties of Bromus with the Uredospores of *Puccinia dispersa* (Erikss.), the brown-rust of these grasses. These results show clearly that, other conditions being the same, the infection of a given species of Bromus—say *B. mollis*—by the Uredospores of the Puccinia depends on the origin of the spores, that is to say, on the circumstances of nutrition and breeding generally to which they have been hitherto accustomed. For instance, if the spores are reared on *B. mollis*, they infect another plant of *B. mollis* readily; but if they are reared on *B. sterilis*, they refuse to infect *B. mollis*, though they will readily infect another plant of *B. sterilis*.

But, in addition to the infective capacity of the spores conditioned by their past history, there is the question of the predisposition or immunity of the host. For instance, it is easy to infect *Bromus mollis* with spores from *B. mollis*, but far less easy to infect *B. racemosus* with such spores, and practically impossible to successfully infect *B. sterilis*. Part of Prof. Marshall Ward's work goes to prove that the immunity of given species of Bromus is not due to anatomical peculiarities, such as the number and size of the stomata, hairs, the volume of chlorophyll tissue and so forth, but to some substances or conditions in the living cells which escape microscopic investigation. In other words, the inquiry is being pushed into the domain of enzyme reactions, anti-toxins and so forth.

In a forthcoming paper it will also be shown that the external conditions of germination of the spores, and of infection by way of the stomata, require far more attention than they have yet received.

In a paper read to the Royal Society on February 20 last, another aspect of the investigation was opened up, namely, the possibility of obtaining pure cultures of these Uredines, a method which applies to other parasitic fungi as well.

In order to obtain more decisive answers to such questions as —Are any of the results obtained on plants in the open, or merely covered with bell-jars and so forth, due to spores accidentally introduced, or to mycelium, &c., already in the plant? a number of infections were made on seedlings germinated and grown antiseptically in tubes as follows :—

Clean picked seeds were placed singly, by means of forceps, on filter paper at the bottom of Petri-dishes properly sterilised by heat. When these had germinated, and observation showed that the whole series was free of moulds or other signs of contamination, the seedlings were removed by means of sterile forceps and transplanted singly into sterilised tubes of various kinds as described below, and the further growth allowed to proceed in the light under conditions varied as will be seen.

Prof. Ward had already shown that seedlings will continue to grow in such tubes, but, as we have seen, in the cases previously described he had no guarantee that the seedlings introduced into the culture-tubes did not already carry on their leaves wind-borne or otherwise transmitted spores.

In the case of these seedlings germinated from clean "seed" in sterile dishes and tubes, it is obvious that the only chance of infection depends on spores attached to the "seed" or on mycelium in the seed.

Experiments with seed gathered even from badly rusted plants and germinated as above have never given rusted seedlings, although other experiments have shown that the germ-tubes of attached spores can infect seedlings when the plumule is only 3–5 mm. high. Nor has Prof. Ward ever been able to discover any trace of mycelium in the seeds.

But if the "seed" of the Bromus is sterilised before germination—as can be done by steeping in various antiseptics, or by heating to 60–70° C.—it is found that pure cultures of the Brome may be obtained in the tubes, and it is then only necessary to infect such a clean seedling with the spores of the parasite to obtain a pure culture of the latter.

Preliminary experiments soon showed that the Brome seedlings thus raised from seeds treated antiseptically, and protected from the first by glass, may be grown for weeks and even for a couple of months in such tubes under proper precautions, and Prof. Ward set himself the task of ascertaining how such cultures would behave in infection experiments.

In the following experiment upright tubes of the kind known to chemists as "drying towers" were prepared as in the diagram (Fig. 1), so that by means of an aspirator attached to the tubing at G, a continuous current of damp air could be slowly drawn through the whole series, aërating the roots of the seedlings F, which burrowed into the cotton-wool B, day and night. The tubes were charged each with one seedling,

grown from seeds heated to 65° C., and forty-eight hours after germination had begun and the latter allowed to grow in the light on a table outside the laboratory. The tubes were charged on June 14, and on June 19, when the first green leaf was well developed, the latter was infected at a definite spot with spores

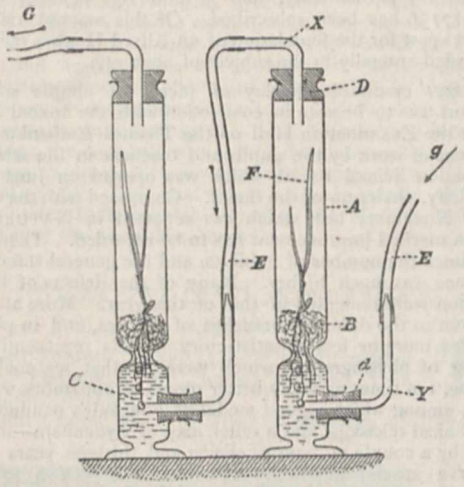

FIG. 1.

Diagram showing arrangement of tubes for pure cultures of grass seedlings—see text—here shown connected up for aëration. Reduced.
A = glass jar. B = cotton-wool saturated with liquid. C = liquid reservoir containing nutritive culture solution, through which air bubbles pass. D and *d* = caoutchouc stoppers pierced by glass tubing. EE = caoutchouc tubing. F = seedling with its roots in B and its leaves in air. G and *g* = arrows showing direction of air current. *x* and *y* = glass tubes.

—proved to be capable of vigorously germinating by cultures in hanging drops—and the whole series linked up and aërated. The growth of these seedlings in the moist air-current was very satisfactory, the plants having a deep rich green colour, though the leaves were short, and the results, as shown in the following table, were very instructive.

In this series the liquid employed was the normal Knop's mineral solution (+), so well known as used in water-cultures. The tubes were charged with this before sterilisation, enough being put in to wet the cotton-wool plug (B) and fill the reservoir (C), the side-tube *y* being fused at its pointed end during sterilising.

Since each tube is linked to its neighbour with clean flexible tubing, and the air bubbles through the liquid in the reservoir (C) and has to pass the cotton-wool plug (B) before reaching the leaves (F) in the air above, there can be no question of infection from outside, and the results also show that *infection only occurs exactly where the spores are placed* on the leaf in each case.

The spores employed were carefully tested as regards their germinating power, and, as the table shows, the results in the closed tubes fully bear out previous experience. In the aspirated tubes, however, the second pair of seedlings of *B. mollis* (No. 712) gave negative results, inasmuch as only flecks, and not pustules bearing spores, were developed. In the closed tubes, however—see below—the positive results, especially on *B. velutinus* and *B secalinus*, were excellent, and subsequent examination showed that the spores germinated well and were capable of infecting other seedlings.

In order to test further the behaviour in mineral solutions, Prof. Ward prepared, as the table shows, several series in closed tubes, Nos. 713, which served as a parallel series to Nos. 711 and 712, but without aëration.

In No. 713 the sterile seedlings were raised antiseptically as before, but the roots merely penetrated cotton-wool saturated with Knop's solution, and held by the constriction over the bulb filled with the same, no air being drawn through. The growth was excellent, and the results very conclusive, as the table shows.

The seedlings were allowed two days at 22–20° C. in the laboratory and then put out side by side with 711 and 712 in full sun during the middle of the day, and after two days' further growth were infected.

By the tenth day the thin leaf was well developed, and the first pustule was seen on *B. mollis* and *B. secalinus* on the eighth day after infection.

The growth of pustules was excellent on *B. velutinus* and *B. secalinus* especially.

This experiment is interesting, not only as showing that plants can be grown and infected successfully in these closed water-cultures, but especially as showing the contrast between the aërated and non-aërated tubes, for, since the infected

Experiments in Aërated and in Closed Tubes. Selected and Sterilised Seeds ana Clean Seedlings. Infected when one week old. Roots in Knop's Solution.

Expt. No.	Date.	Host.	Origin of spores.	Treatment.	Results.	Period of incubation.	Period of experiment.	Remarks.
711	June 19	*B. sterilis* ...	*B. mollis*	Aërated continuously	—		21 days	
,,	,,	,,	,,	,, ,,	—		,,	
,,	,,	*B. mollis* ...	,,	,, ,,	+	12 days	,,	
,,	,,	,,	,,	,, ,,	+	16 ,,	,,	
712	,,	*B. sterilis* ...	,,	,, ,,	—		,,	
,,	,,	,,	,,	,, ,,	—		,,	
,,	,,	*B. mollis* ...	,,	,, ,,	?		,,	Flecks developed, but no spores formed.
,,	,,	,,	,,	,, ,,	?		,,	Flecks developed, but no spores formed.
713	,,	,,	,,	Closed tubes	+	8 ,,	,,	
,,	,,	,,	,,	,, ,, ...	+	12 ,,	,,	
,,	,,	*B. sterilis* ...	,,	,, ,, ...	—		,,	
,,	,,	,,	,,	,, ,, ...	—		,,	
,,	,,	*B. velutinus* ...	,,	,, ,, ...	+	10 ,,	,,	Very fine growth of sporiferous pustules.
,,	,,	*B. maximus*	,,	,, ,, ...	—		,,	
,,	,,	*B. madritensis*	,,	,, ,, ...	—		,,	
,,	,,	*B. commutatus*	,,	,, ,, ...	+	10 ,,	,,	
,,	,,	*B. arvensis* ...	,,	,, ,, ...	—		,,	
,,	,,	*B. secalinus* ...	,,	,, ,, ...	+	8 ,,	,,	Very fine pustules.
,,	,,	*B. interruptus*	,,	,, ,, ...	+	10 ,,	,,	
,,	,,	*B. racemosus*...	,,	,, ,, ...	+	11 ,,	,,	

seedlings were selected in each case from the same Petri-dish cultures, we must assume that the difference in rate of development was due to the difference of ventilation, and perhaps conclude that this interferes with the success of the parasite, as measured by the somewhat longer incubation period. It is remarkable how dwarfed the continuously aërated plants are, compared with those in closed tubes, owing to the elongation of the leaves of the latter.

It is clear, therefore, that pure cultures of Uredospores can be obtained by this method, and it is equally clear that we can also obtain pure cultures of the host-plants, and since we can do this, there is no reason why the infection of Uredineæ should not be conducted as rigorously and exactly as that of bacteria. As a matter of fact, Prof. Ward has succeeded in proving that it can,[1] though of course the length of time occupied in a large series of cultures and infections will prove troublesome, and it remains to be seen whether we can get such plants to flower (see Fig. 2).

FIG. 2.—Pure culture of *Puccinia dispersa* on *Bromus velutinus*. The "seed" of the grass, antiseptically sterilised as regards fungus spores by heating to 65° C., was germinated in the sterile tube and infected on the first leaf with spores developed on *Bromus mollis*. The infection was successful, and pustules of spores have appeared *only on the area inoculated.*

A number of isolated tube-cultures were made with spores from *B. sterilis*, *B. mollis* and *B. secalinus*, and arranged similarly, and confirmatory results obtained. Moreover, Prof. Ward was able in several cases to transfer successfully spores from these pure tube-cultures to other tubes of pure cultures of seedlings, and to prove that the spores raised under strictly antiseptic conditions are capable of germination and infection.

At the same time, it was noteworthy that in several cases the antiseptically raised spores were not always successful in infecting the seedlings, and it remains for further investigation to determine whether this was due to the conditions of culture of the fungus or the host, or both.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

A DISCUSSION upon the clause of the Education Bill referring to the provision to be made for secondary education took place in the House of Commons on Monday. An amendment was moved to make the clause compulsory instead of optional, the contention being that many local authorities will do nothing for secondary education if the decision as to the needs of their localities is left to them. After discussion, Mr. Balfour consented, as a compromise, to introduce words which, while not making the clause mandatory or throwing upon the Education Department the task of declaring what educational provision should be made in each county, emphasised the fact that the education authorities were expected to supply higher education. The words to which he agreed were:—"The local authorities shall consider the needs of education, and take such steps as may seem desirable, after consultation with the Board of Education, to aid or supply education other than elementary."

THE following teachers have been appointed by the Senate of the University of London, in connection with the grant of 10,000*l.* a year recently voted to the University by the London County Council in aid of the work of the faculties of arts, science, engineering and economics:—Prof. Ramsay, F.R.S., teacher of chemistry, at University College; Prof. Capper, teacher of mechanical engineering, at King's College; Prof. Unwin, F.R.S., teacher of civil and mechanical engineering, at the Central Technical College.

AN anatomical museum, endowed in memory of the late Prof. A. Hughes, was formally opened at the South Wales and Monmouthshire University College on Saturday. Prof. Hughes, who died of enteric fever contracted in South Africa, was the first occupant of the chair of anatomy at the College, and when he left to take a similar position at King's College, London, he gave 350*l.* with which to purchase the nucleus of the anatomical museum. To his memory and in recognition of his special services to medical education in Wales, it was decided to endow the museum permanently, and a fund was opened, towards which 1775*l.* has been subscribed. Of this amount 120*l.* has been set apart for the foundation of an Alfred Hughes medal, to be awarded annually in the subject of anatomy.

A VERY creditable display of pieces of simple scientific apparatus was to be seen in connection with the annual exhibition, at the Examination Hall on the Thames Embankment, of specimens of work by the pupils and teachers in the schools of the London School Board, which was opened on June 18 by Lord Reay, chairman of the Board. Compared with the exhibition of November last, which was reported in NATURE (No. 1671), a marked improvement has to be recorded. There were three times the number of exhibits, and the general standard of excellence was much higher. Many of the defects of the last exhibition were remedied in that of this year. More attention was given to the different branches of physics, and in place of the three more or less unsatisfactory models representing the teaching of physiography, which were all that we could find last time, ten times as many better pieces of apparatus were included, among which a good model of Foucault's pendulum, an astronomical telescope and a relief map of Sydenham—the last-named by a couple of boys of eleven and thirteen years of age—deserve special mention. The chemical section provided abundant evidence of the influence of Prof. Armstrong on the teachers of this subject. It was clear from the exhibits in this department that every effort is being made to develop the child's intelligence by encouraging him to discover facts for himself. Though more attention was given to nature-study than was the case last year, there is still plenty of room for development in this direction. The undesirable plan of mixing up the work of teachers and taught was followed again, but it is to be hoped that the committee of management may be persuaded, before holding another exhibition, of the difficulty experienced by the visitor in knowing, without consulting a bulky catalogue, when an exhibit is the work of a pupil and when that of the instructor. It is impossible in this place to describe the exhibits in detail, but a good Wimshurst machine constructed by a boy of fourteen was an excellent instance of the trouble a youngster will take when once he has been interested in the subject of study.

SCIENTIFIC SERIALS.

American Journal of Science, June.—Fossil faunas and their use in correlating geological formations, by Henry S. Williams. It is shown that the plan usually followed of classifying geological formations in time by means of a comparison of one predominant fossil is wanting in accuracy. Very many single species, the range of which has been established by thorough study of the successive formations in which they occur, range through a third, and often a half, of one of the standard geological systems. A second reason for not resting implicit confidence on this method of correlation is the frequently observed fact that parts of the geological column of different sections, which upon satisfactory stratigraphic grounds are known to be stratigraphically equivalent, contain different fossils.—Studies of the Eocene mammalia in the Marsh collection, Peabody Museum, by J. L. Wortman. The present instalment of this series contains detailed descriptions of *Sinopa rapax* and *Sinopa agilis*.—The transmission of sound through solid walls, by F. L. Tufts. The rigidity of the material was found to be the main factor in determining the intensity of the sound transmitted from the air on one side to the air on the other, the only other factor possessing any influence being the mass.—A new gauge for the measurement of small pressures, by E. W. Morley and C. F. Brush. A description of a form of differential mercury pressure gauge resembling in principle that recently described by Lord Rayleigh. Two modes of reading are given; in the second method a reading can be taken in ten seconds. With suitably mounted instruments pressures may be read with a mean error of not more than a ten-thousandth of a millimetre.—On a hitherto untried form of mounting either equatorial or azimuth, for a telescope of exceptional size, either reflector or refractor, in which telescope, observing floor and dome are combined in one,

[1] *I.e.*, of course so far as fungi are concerned; the antiseptic treatment adopted does not always exclude harmless bacteria.

by D. P. Todd.—On the occurrence of uranophane in Georgia, by T. L. Watson.—The internal structure of cliftonite, by J. M. Davison. The view of Fletcher that this form of crystallised carbon is a pseudomorph after pyrite is not confirmed by these experiments.

Journal of Botany.—The June number opens with notes on Mycetozoa by Mr. Arthur Lister, F.R.S., and Miss G. Lister. Two species are figured and described; of these *Physarum gyrosum* is allied to *Fuligo septica*, while the other, *Chondrioderma asteroides*, is a new species which was found on pine needles and acacia leaves at La Mortola. In addition, the nomenclature of certain Mycetozoa collected by Dr. Celakovsky in Bohemia is discussed and revised. To the lists of Sussex plants already published by Mr. E. S. Salmon and Mr. Whitwell during the past half year is added another referring mainly to the west Arun district of west Sussex, contributed by Rev. E. S. Marshall. The catalogue of British marine algæ compiled by Mr. Batters which began in the March number has now reached the genus Ectocarpus.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, May 15.—"On Microscopic Effects of Stress on Platinum." By Thomas Andrews, F.R.S., F.C.S., and Charles Reginald Andrews.

The microscopic effects of stress on platinum do not appear to have been studied. An ingot of pure platinum was therefore prepared, and from this a portion was accurately machined in the form of a cube, 0·30 inch square, which was afterwards carefully microscopically polished and then subjected to compressive stress in the testing machine.

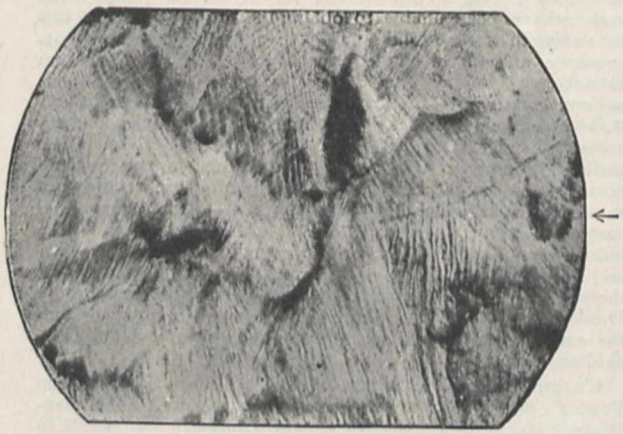

FIG. 1.—Magnification 120 diameters.

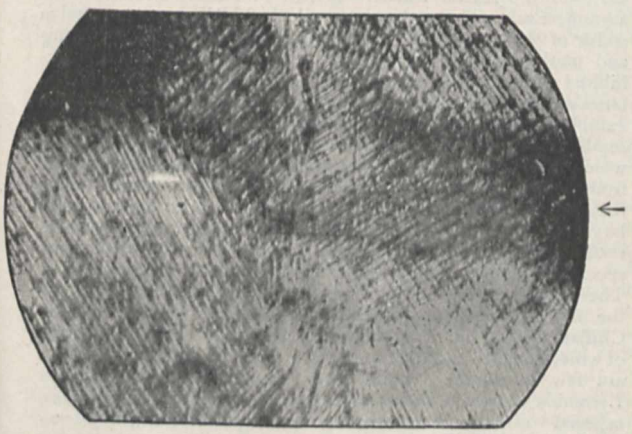

FIG. 2.—Magnification 250 diameters.
Microscopic effects of compressive stress on platinum showing crystalline slip as seen in section.
Arrow indicates direction of compressive force.

Prior to the application of stress, and for comparative purposes, a polished face of the platinum cube was microscopically examined, but an even polished surface only was observed. A force producing a compression of 10 per cent. on the total height of the cube was then applied, and microscopic observations were taken at high magnifications of the effects of the stress on the microcrystalline structure of the platinum cube.

The polished side of the cube upon which the high-power microscopic examination was made was the one in line, or in parallel, with the direction of the compressive force.

Owing to the varied orientation of the different crystals in the mass of the platinum, the lines of cleavage as indicated by the minute "slip bands," were often seen at varied angles to the line of the straining force.

The general appearance of the disintegration of the large or primary crystal grains, produced by the pressure, on the pure platinum cube, was the apparent breaking up of the crystalline structure of the metallic mass, as seen in section, roughly diagonally to the line of the compressive force. The area enclosed by the main lines of disruption roughly approximating to the size of the large primary crystal grains.

The distances between the extremely fine lines, or "slip bands," appeared roughly to coincide proportionately with the size of the secondary or most minute crystals forming the mass, the finer "slip bands" appearing to indicate the crystalline slip which had taken place along the facets of the smaller or secondary crystals. The direction, however, of the main lines of the crystalline disruption did not appear always to coincide with the intercrystalline facet junctions of the large or primary crystal grains. The lines of least resistance, or greatest crystalline slip, seemed chiefly to develop at an approximate angle of about 45 degrees to the pressure line, as previously mentioned; but the line of greatest weakness in the mass structure of the metal was not always at that angle with the line of the disruptive force.

The authors hope that these experiments may prove of use in affording an indication of the comparative behaviour of the noblest metal platinum, with the behaviour of the constructive metals, copper, nickel, iron and steel, when under the influence of stress; and the experiments have also shown that the microscopic influences of stress in the heavy metal platinum are analogous to those which have been observed in metals of lower specific gravity.

June 5.—"Contributions to the Study of Flicker." Paper ii. By T. C. Porter, M.A., Eton. Communicated by Lord Rayleigh, F.R.S.

This paper is the sequel to that already published in the *Proceedings*, vol. lxiii. It first details various precautions which experiments, carried out since that paper, have shown to be necessary in estimating the rate at which a black disc with a white sector must be rotated in order that the sensation of flicker may just vanish. Results are given which prove that the central portion of the retina is less sensitive to flicker than its outer region. The effect on the flicker of the measured want of blackness in the black sector is also discussed. The most important results of a long series of experiments, in which many observers took part (in order to eliminate as far as possible the personal equation), is to prove that, if n be the number of rotations per second of the disc when flicker just vanishes, the angular magnitude of the white sector being kept constant, but the illumination of the disc being varied, by altering its distance from a measured and constant illuminant, then $n = a + b \log I$, where a is a constant, and b is also a constant for all illuminations between a very feeble one and one under which the disc becomes almost unbearably bright. A full description of the illuminants used and of the measurement of the illuminations caused by them on the disc is given in the paper. At very low illuminations it is proved that the value of b changes with unexpected rapidity, apparently becoming again constant. The bearing of the above equation on the practical value of the flicker photometer, and also the number of kinematograph photographs which must be projected on a screen per second in order to get rid of flicker, is stated.

The second important result is the experimental determination of n, when the illumination of the disc is kept constant, but its apparent brightness is altered by altering the angular magnitude of the white sector. If this last, measured in degrees, is called w, the magnitude of the black sector will be $360 - w$, and if

c and d are constants, then the relation connecting these quantities with n is $n = c + d \log w(360 - w)$. If the distance of the disc from the illuminant is now varied, so that I varies, the equation connecting all these quantities with n (the number of rotations of the disc per second when flicker just vanishes) is $n = k + k' \log I. \log w(360 - w)$, where k and k' are constants (though it must be remembered that k' has a different value for very feeble illuminations). All these results are clearly exhibited in the paper by numerous interesting curves. It is also shown that the different curves obtained by placing the disc in the different colours of the same spectrum, and varying the angle of the white sector by steps of 10° from 0° to 180° in each colour, can all be obtained by viewing the disc illuminated by *white* light and simply varying the intensity of the illumination, which proves that n is unaffected by the wave frequency of the different colours and is solely influenced by their intensity.

Finally a curve, showing the relative intensity of the light of different parts of the same spectrum, deduced from the results of the present paper, is given, and proves to be actually coincident, within the errors of experiment (except for the very faint illuminations at the two ends of the visible spectrum) with the curve expressing the same thing given by Vierordt, but obtained by him, as by Abney and others, in an altogether different way.

"The Spectra of Potassium, Rubidium and Cæsium, and their Mutual Relations." By Hugh Ramage, B.A., St. John's College, Cambridge. Communicated by Prof. G. D. Liveing, F.R.S.

Tables of the oxyhydrogen flame spectra of the above three metals are given, which contain a number of lines not hitherto recorded. The lines which form the second subordinate series of cæsium and several members of the corresponding series of rubidium are new; so also are some of the lines of the first subordinate and the principal series of both metals. The flame spectra were photographed with a spectrometer fitted with a Rowland plane grating; spark spectra of iron, titanium, &c., were superimposed on the flame spectra to furnish fiducial lines. Some of the lines in the red region of the spectrum were measured by eye observations.

Diagrams of the subordinate series in the spectra were drawn to scales of oscillation frequencies for abscissæ and (1) atomic masses, (2) squares of atomic masses for ordinates. The conclusions deduced in the author's previous paper (*Roy. Soc. Proc.*, vol. lxx. p. 1, 1902) from less complete data were amply confirmed. There is undoubtedly a very close connection between these series and the atomic masses, and the lines which connect the corresponding members of homologous doublets in diagram (2) do intersect on the ordinate of zero atomic mass. The points which bisect the limits towards which the subordinate series converge in each spectrum lie on straight lines in diagram (1). The constants in Rydberg's general formula were then expressed in terms of the atomic masses; the oscillation frequencies of the lines, calculated from the modified formula, are given in the paper, together with the observed numbers. The convergence points of the series were calculated by different methods and the results are given. It would appear from these that the two subordinate series do not converge towards the same limits.

All the strong lines and nearly all the weak lines which have been observed in the flame and arc spectra of these three metals are included in the three harmonic series. The differences between the corresponding series in the spectra appear to depend on the atomic masses alone. Reasons are also given for thinking that the principal and the second subordinate series are more closely related to each other than to the first subordinate series.

Chemical Society, June 5.—Dr. Thorpe, C.B., F.R.S., in the chair.—The action of ungerminated barley diastase on starch, part i., by Dr. J. L. Baker. The hydrolytic products of this action are a new amylodextrin and maltose. The former is slowly converted by the further action of the enzyme into maltose and a small proportion of dextrose. The decomposition of chlorates, part v., potassium chlorates in presence of oxides of manganese and the theory of perchlorate formation, by Mr. W. H. Sodeau. It is shown that, since the amount of chlorine produced by heating potassium chlorate in presence of manganese dioxide is not increased by reduction of pressure, no secondary reaction can occur, and therefore McLeod's theory of permanganate formation is untenable.—Studies in the tetrahydronaphthalene series, i., the diazo-amino-compounds of *ar*-tetrahydro-β-naphthalene, by Mr. C. Smith.—Experiments on phosphorus tetroxide, by Mr. C. A. West. When phosphorous oxide, P_4O_6, is heated at 300°, it decomposes into phosphorus tetroxide and free phosphorus. The former is an extremely stable substance, volatilising only with difficulty at 1400°. Its composition is represented by the formula P_8O_{16}. The decomposition of compounds of selenium and tellurium by moulds and its influence on the biological test for arsenic, by Dr. Rosenheim. Certain moulds, such as *Aspergillus*, *Mucor* and *Penicillium*, decompose tellurium and selenium compounds with the production of a fæcal odour which masks the garlic odour given off by these moulds when grown in arsenical solutions.—Constituents of gambier and acacia catechus, by Messrs. A. G. Perkin and E. Yoshitake. The authors have isolated from these sources three closely related substances, distinguished as catechins *a*, *b* and *c*.—The decomposition of oxalacetic hydrazone in aqueous and acid solutions, and a new method of determining the concentration of hydrogen ions in solution, by Messrs. H. O. Jones and O. W. Richardson. When the hydrazone is heated in aqueous solution it decomposes into pyruvic hydrazone and pyrazolone carboxylic acid, the production rate of the former being proportional to the concentration of the original hydrazone, and of the latter to the concentration both of the hydrazone and the hydrogen ions.—The dissociation constants of oxalacetic acid and its hydrazone, by Messrs. H. O. Jones and O. W. Richardson.—Derivatives of butyrylpyruvic acid, by Dr. A. Lapworth and Mr. A. C. O. Hann.—Sulphocampholene carboxylic acid, by Mr. A. W. Harvey and Dr. Lapworth.—Some properties of camphorquinonephenylhydrazone, by Dr. A. Lapworth and Mr. A. C. O. Hann. The authors have been unable to obtain the "keto" form of this substance in a pure state, but have obtained evidence of its existence and have studied the rate at which equilibrium between the "keto" and "enol" forms is attained under various conditions.—Optically active esters of β-ketonic and β-aldehydic acids, part i., menthyl hydroxymethylenephenylacetate, by Dr. Lapworth and Mr. A. C. O. Hann. The authors propose to investigate these esters in the hope of obtaining an insight into the peculiar tautomeric relations of the acids from which they are derived.—Part ii., menthyl acetoacetate, by Dr. Lapworth and Mr. A. C. O. Hann.—The mechanism of simple desmotropic change, by Dr. Lapworth and Mr. A. C. O. Hann. An extension of Brühl's views on the mechanism of tautomeric change.—Trimethylbrazilone, by Dr. W. H. Perkin, jun. An investigation is being made into the constitution of this substance, which is obtained by the oxidation of brazilin.

Entomological Society, June 4.—The Rev. Canon Fowler, president, in the chair.—Mr. H. W. Shepheard-Walwyn exhibited a male specimen of *Lampides baeticus* taken recently emerged at Winchester in September, 1899, and two varieties of *Lycaena icarus*.—Mr. C. P. Pickett exhibited one asymmetrical male and two females of *Dilina tiliae*, and a series of the same insect showing great variation in colouring and markings, bred during May, 1902.—Mr. F. Merrifield exhibited photographs showing the protective resemblances of the larva and pupa of *Hygrochroa syringaria*.—Prof. E. B. Poulton exhibited a lantern slide showing the perfect protective resemblance of *Hybernia leucophaearia* to the oak trunk upon which it rested.—Mr. A. Bacot exhibited hybrid larvæ resulting from a pairing between a male *Malacosoma neustria* and a female *M. castrensis*, also larvæ of *M. neustria* and reputed larvæ of *M. franconica* for comparison.—Mr. H. C. Elwes read a paper on the butterflies of Chile, illustrated with many specimens taken during an expedition last winter to that country. The poverty of the Chilian rhopalocerous fauna is notable. Of the insects represented there was probably only one really Chilian Colias, the most numerous family being the Satyridæ, of which some twenty-five species were taken. The Nymphalidæ are few in number, while three native Theclids and three Lycænids represent their respective groups. Mr. Elwes drew especial attention to one unique species, *Argurophorus argenteus*, which flies at 3000 to 7000 feet, the upper-side of all the wings in male and female being unicolorous and brilliant metallic silver, the under-side resembling somewhat that of the Holarctic family Œneis. A similarly beautiful golden sheen was observable on *Cyclopides puelmae*, a species of Hesperid, but on the ground of protective coloration there seemed nothing in the surroundings of either insect to account for the peculiarity. Between alpine and lowland species there was no distinction,

although the season on the coast would be over when that upon the high mountains commenced.—Mr. S. L. Hinde read a paper, illustrated by lantern slides, upon the protective resemblance to flowers borne by an African Homopterous insect, *Flata nigrocincta*, Walker. He said that "the cluster of insects grouped to resemble a flower spike," which forms the frontispiece of Prof. J. W. Gregory's "Great Rift Valley," had attracted some criticism, and that as he was familiar with the insect figured, and with its larva, in a wild state, it seemed desirable to publish the evidence. In the plate the insects are collected on the vertical stem, the green individuals uppermost considerably smaller than the red ones beneath, like the unopened green buds towards the top of a flowering spike as compared with the expanded blossoms below. The separate representations of the green and red forms, however, indicate no difference in size, and experience confirms this conclusion, so that the impression conveyed by the frontispiece plate is erroneous. After further noting that the uniform deep pink colour of the exposed parts of the insects figured was also incorrect, Mr. Hinde remarked that he had never seen the insects grouped according to their colours, but invariably mixed, that he had never found larvæ and imagines on the same stem or even together on the same tree or bush, nor did the imagines affect vertical stems, but always those actually or approximately horizontal. Sir George Hampson said the insects figured were orange when brought home, and the pink-winged imago was an error of the colorist.

Mineralogical Society, June 10.—Dr. Hugo Müller, president, in the chair.—Dr. A. Hutchinson gave an account of the experiments he had made in order to discover the cause of the discrepancy in the results obtained by Meigen and Panebianco in the application of Meigen's method of discriminating calcite and aragonite. He found that calcite, when treated with a boiling dilute solution of cobalt nitrate, only remains white or becomes yellow (as stated by Meigen) when the cobalt nitrate contains traces of iron, and that Panebianco's lavender-blue colour is only obtained when the cobalt nitrate is free from iron.—Mr. G. F. Herbert Smith discussed some crystals of krennerite from Nagyag on which he found a large number of forms not previously recorded. He further exhibited the new three-circle goniometer recently constructed from his designs by Messrs. Troughton and Simms for the British Museum. He pointed out the advantages of the gnomonic projection in crystallography, and showed a table which he had prepared to facilitate the employment of this method of projection.—Mr. G. T. Prior exhibited specimens and described the mineral constituents of the volcanic dust which fell in Barbados on May 7 and 8 after the eruption of the Soufrière of St. Vincent. The fact that the constituents are like those of a hypersthene-augite-andesite connects the eruptions with the Pacific rather than with the Atlantic volcanic chain.—Mr. L. J. Spencer pointed out reasons for the non-existence of "kalgoorlite" and "coolgardite" as mineral species. At Kalgoorlie, in Western Australia, with the tellurides of gold and silver, sylvanite ($(Au,Ag)Te_2$), calaverite ($(Au,Ag)Te_2$), and petzite ($(Ag,Au)_2Te$), is frequently associated the telluride of mercury, coloradoite. The iron-black petzite and coloradoite are identical in external appearance, and sometimes occur intimately associated together. In such cases minute fragments detached from an apparently homogeneous mass are found on blow-pipe analysis to be sometimes coloradoite and sometimes petzite. Analysis of larger pieces would therefore show the presence of tellurium, gold, silver and mercury in variable proportions, as is actually the case in the analysis of "kalgoorlite" and "coolgardite," described as new mineral species by Pittman in 1897 and by Carnot in 1901 respectively. Neither of these investigators appears to have been aware of the occurrence of coloradoite at Kalgoorlie, and the materials they analysed were without doubt mechanical mixtures of coloradoite and the above-mentioned tellurides of gold and silver, especially petzite.—Mr. R. H. Solly described the crystallographic characters of liveingite, a new sulph-arsenite of lead ($5PbS.4As_2S_3$) from the Binnenthal, a preliminary account of which was given by him in the *Proc. Cambridge Phil. Soc.*, 1901, xi. p. 239. Measurements of three good crystals more recently obtained, showed that the system was orthorhombic, and that 100, 110 = 44° 49′; 010, 011 = 46° 48′; 001, 101 = 43° 23′. In the prism zone the faces (210), (430), (540), and in the macrodome zone the faces (302), (504), (908), (101) are well developed, and (100) is a cleavage plane. A pyramid zone with numerous small faces is also present. The crystals often exhibit a polysynthetic growth parallel to (100). In appearance they resemble rathite.

Mathematical Society, June 12.—Dr. E. W. Hobson, president, in the chair.—The president announced that the council had awarded the De Morgan medal, 1902, to Prof. A. G. Greenhill.—Prof. Love communicated a paper by Prof. Conway on Huygens' principle in a uniaxial crystal. It is shown that, when electric waves are propagated in a crystalline medium with an axis of symmetry, the radiation is resolvable into constituents (1) with electric force at right angles to the axis, (2) with magnetic force at right angles to the axis, (3) with both forces at right angles to the axis. The types of radiation that are due to electric and magnetic doublets with their axes parallel and perpendicular to the axis of symmetry are determined, and it is shown that the radiation received at any point can be regarded as made up of secondary waves due to such doublets distributed upon an arbitrary surface separating the point from the actual sources of the radiation.—Lieut.-Colonel Cunningham gave an account of some investigations on repetition of the sum-factor operation. The result of the repetition of the operation upon a number is very frequently unity when the operation is repeated sufficiently often; in the case of one small class of numbers the result is a perfect number; in another small class, a pair of amicable numbers; in a third small class, the result may increase beyond the power of practical calculation.—The following papers were communicated from the chair:—M. E. Picard, Sur un théorème fondamental dans la théorie des équations différentielles. This note deals with the question of the possibility of the existence of a non-holomorphic integral, which, besides satisfying a given ordinary differential equation, also satisfies a special condition at a certain point.—Mr. G. H. Hardy, some arithmetical theorems. Cauchy's theory of residues is used to obtain various relations between sums of terms of the form $\left(\left(\frac{\sigma b}{a}\right)\right)$, in which a and b are fixed integers, and σ is an integer which ranges over a certain set of values, the summation is taken with respect to σ, and $((x))$ denotes the algebraic difference between x and the absolutely nearest integer.—Prof. M. J. M. Hill, on a geometrical proposition connected with the continuation of power series. A power series with a circle of convergence C_1 having been derived from a given power series with a circle of convergence C_0, it is possible to choose successive positions of a point x, so that every point of the region that is common to C_0 and C_1 shall be within one at least of the circles described with x as centre to touch C_0 and C_1 internally.—Mr. J. H. Grace, on types of perpetuants. The numbers of perpetuants of one or more forms have been determined by Stroh and MacMahon, and the latter has accounted for each perpetuant by a corresponding umbral form. In the present paper the perpetuants of any number of forms are found by the direct reduction of Aronhold's symbolical forms.

Royal Meteorological Society, June 18.—Mr. R. Inwards, vice-president, in the chair.—Mr. F. C. Bayard read a paper on English climatology, 1891–1900, which is a discussion of the climatological data printed in the "Meteorological Record." In 1874, the Royal Meteorological Society commenced the organisation of a series of stations at which the observations are made twice a day on a uniform plan, so that the results may be strictly comparable with each other. In addition to these the Society in 1880 organised another class of stations, termed "climatological," at which the observations are made once a day, viz. at 9 a.m. Mr. Bayard on a former occasion worked up the results from these climatological stations for the ten years 1881–90, and in the present paper he gives the averages from sixty-nine stations for the ten years 1891–1900. The elements dealt with are temperature, relative humidity, amount of cloud, rainfall and rainy days, and the results are a valuable contribution to the climatology of the British Isles.—A paper by Mr. W. L. Dallas on earth temperature observations recorded in Upper India was also read, in which the author discussed the observations made on the temperature of the soil at three stations, viz. Lahore, the capital of the Punjab; Dehra Dun, in the north-west of the North-Western Provinces; and Jaipur, the capital of the native State of that name. The observations, which were made at depths varying from 4 inches to 45½ feet below the surface, extended from 1884 to 1899.

PARIS.

Academy of Sciences, June 16.—M. Bouquet de la Grye in the chair.—On anomalous dispersion in correlation with the absorbing power of bodies for radiations of a determined period, by M. J. Boussinesq.—Arsenic as a normal constituent of animals, and its localisation especially in their ectodermic organs, by M. Armand Gautier. Remarks on a note of M. Gabriel Bertrand, and replies to the criticisms of Hödlmoser, Cerny and Ziemke. The author points out that his positive results for certain parts of the body were always accompanied by parallel experiments with the same reagents upon other portions of the body in which negative results were obtained. The fact that under proper conditions arsenic is only normally found in the skin, nails, thymus and thyroid gland is of the highest importance in toxicological researches. Stress is laid upon the attention to detail necessary to secure trustworthy results.—Dissociation of the elements of the energy expenditure of motors employed in overcoming frictional resistances, by M. A. Chauveau.—On the mode of multiplication of Trypanosomes in fishes, by MM. A. Laveran and F. Mesnil. *Trypanosoma Remaki* and *Trypanoplasma Borreli* both multiply by binary division similarly to *Tr. Brucei* previously described. A fish carrying these parasites can easily inoculate another of the same species. The parasites do not appear to have any pathogenic action on the fish.—On a hypothesis concerning the origin of satellites, by M. L. Picart. A consideration of the question as to the possibility of small planets or comets being converted into satellites of a larger planet. None of the satellites of the known planets correspond to the conditions necessary for this view.—On certain couples of applicable surfaces, by M. Maurice Fouché.—On the integration of differential systems which are completely integrable, by M. E. Cartan.—On the displacement and disturbance of equilibrium, by M. Jouguet.—The electric discharge in flame, by M. Jules Semenov.—On the electrostatic effects of a magnetic variation, by M. V. Crémieu. In reply to the criticisms of M. Carvallo, the author describes the latest form of apparatus used by him. Although, according to the Maxwell theory, the effects produced should have been quite appreciable, the results have been uniformly negative. The conclusions arrived at in the earlier work of the author on the non-existence of electric forces created in dielectrics by magnetic variations are completely confirmed by the later work.—On a magnetic disturbance observed at Athens on May 8, by M. D. Eginitis. The magnetic disturbance coincided with the eruption of Mont Pelée. From the fact that the seismograph showed absolutely no disturbance, and that a similar phenomenon was simultaneously observed at Paris, it is concluded that the disturbance must have been of a magnetic or electric nature.—The polymerisation and heat of formation of oxide of zinc, by M. de Forcrand. On ignition, zinc oxide undergoes a change into a polymeric modification with the evolution of heat.—Combinations of hydrogen sulphide with anhydrous aluminium chloride, by M. E. Baud. By the action of liquid sulphuretted hydrogen upon anhydrous chloride of aluminium, two compounds are formed, one, $Al_2Cl_6.H_2S$, stable at the ordinary temperature, the other, $Al_2Cl_6.2H_2S$, dissociable at about $-45°$ C.—On the alloys of cadmium and magnesium, by M. O. Boudouard. Two definite alloys of these two metals have been isolated, CdMg and $CdMg_4$. The study of the fusibility curves pointed to the existence of a third, $CdMg_{30}$, but this could not be definitely isolated.—On the existence of arsenic in the organism, by M. Gabriel Bertrand. The author has elaborated the method of M. Gautier for the determination of minute quantities of arsenic in organic material, and is able to detect with certainty as little as 1/1000th of a milligram. The results of M. Gautier are generally confirmed. A point of especial interest was the proof of arsenic in the thyroid glands of *Phoca barbata*, captured near Spitzbergen, a case to which the theory of industrial contamination could not possibly be applied.—On isomerism in the benzylidene-methones and on the preparation of an α-methyl-α-isopropyladipic acid identical with dihydrocamphoric acid, by M. G. Martine. The identity of the acid obtained by the oxidation of benzylidene-menthone with potassium permanganate with the dihydrocamphoric acid of Crossley and Perkin has been completely proved.—Pyromucic and isopyromucic acids. The action of phosphoryl chloride and phophorus pentachloride, by M. G. Chavanne. Isopyromucic acid differs from the isomeric pyromucic acid in not being a true acid, and is apparently a phenol.—On a new glucoside, aucubine, extracted from the seeds of *Aucuba japonica*, by MM. Em. Bourquelot and H. Hérissey. The new glucoside occurs in the seeds mixed with a large quantity of cane sugar, from which it can be separated by fermentation of the sugar by yeast. Dextrose is one of the products of hydrolysis of the glucoside.—On the production of glycose by the muscles, by MM. Cadéac and Maignon. The muscles resemble the liver in producing sugar after death, the amount produced being a function of the temperature to which the muscle is exposed. This action is in no way connected with putrefaction.—On the hæmolytic action of cobra poison, by M. A. Calmette.—Permanent contraction in the pigeon, by M. Louis Boutan.—On the aërobic fermentation of manure, by M. C. Dupont. The aërobic fermentation of farm manure is due to two bacteria, *Bacillus mesentericus ruber* and *Bacillus thermophilus Grignoni*; these bacteria burn the nitrogenous materials, sugars, starches and gums.—On the internal morphology of the genus Thylacoplethus, a parasite of the Alpheidæ, by M. H. Coutière.—On the impressions produced under the influence of certain gases, by M. A. J. J. Vandevelde. The author has produced images similar to those described by MM. Vignon and Colson, making use for this purpose of hydrogen sulphide, ammonia, hydrochloric acid and iodine.—On the subterranean river of Trépail, Marne, by M. E. A. Martel.—Physiological photometry, by M. G. M. Stanoiévitch.—A new method of measuring muscular sensibility, by MM. Toulouse and Vaschide.—On a vertical series of densities of sea water of the Mediterranean, by M. J. Thoulet.

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