Mars, and Saturn, obtained at the Lick Observatory. To the *English Illustrated*, Mr. Grant Allen contributes another "Moorland Idyll"; and the inhabitants of "The Monkey House in the Zoo" are described and illustrated by Mr. F. Miller. In the *Humanitarian*, Mr. J. G. Raupert has a pseudo-scientific article upon "Some Results of Modern Psychical Research"; and in *Chambers's Journal*, there are articles worth reading on death from snake-bite in India, the Carstairs Electric Light Railway, and citric acid. Geographers will be interested in a paper on "England and France in the Nile Valley," contributed by Captain F. D. Lugard to the *National*. Here we may also mention that the *Geographical Journal* contains a valuable paper in which Dr. H. R. Mill describes his bathymetrical survey of the English lakes. *Good Words* has an illustrated article upon the manufacture of coal-gas, but neither *Scribner* nor the *Sunday Magazine* have articles calling for comment in these columns.

THE RELATION OF BIOLOGY TO GEOLOGICAL INVESTIGATION.[1]

I.

THE CHARACTER AND ORIGIN OF FOSSIL REMAINS.

IN prosecuting the study of the fossil remains of animals and plants, the investigator may have either one or the other of its two leading objects in view; but each being so closely related to the other, it is always essential that they should be pursued with direct relation to each other. In the first case, the leading object to be attained is the extension of our knowledge of the animal and vegetable kingdoms far beyond that which may be acquired by the study of living animals and plants; and in the second case, it is to apply that knowledge to the study of structural and systematic geology. The object in the first case is purely palæontological; in the second, it is not only to acquire palæontological knowledge, but to apply it to various branches of geological investigation.

There are seven different natural conditions in which fossil remains are recognisable, three of which relate to substance, three to form, and one to both. To those relating to substance the terms permineralisation, histometabasis, and carbonisation are here applied; to those relating to form, the terms moulds, imprints, and casts; and to the one relating to both form and substance, the term pseudomorphism.

The term permineralisation applies to that condition of fossil remains of animals which differs least from their original condition as parts of living animals; such, for example, as bones of vertebrates, shells of molluscs, tests of crustaceans, &c. The term histometabasis is applied to that condition of fossilisation in which an entire exchange of the original substance for another has occurred in such a manner as to retain or reproduce the minute and even the microscopic texture of the original. Pseudomorphism of fossils is so nearly like that of mineral crystals, that this term is equally applicable to both. It consists in the replacement of the original substance of the fossil by a crystallisable or crystallised mineral, such, for example, as calcite, pyrite, quartz in the form of chalcedony, &c., the original form of the fossil being perfectly retained. The term carbonisation is applied in this connection only or mainly to such masses of vegetable remains as coal, lignite, and peat. Moulds are cavities in sedimentary rocks which were originally occupied by fossils, the latter having been subsequently removed by the percolation of water containing a solvent of the fossils but not of the rock. Imprints do not differ materially in character from moulds, the former term being usually applied to impressions left in the rock by thin substances like leaves of plants, wings of insects, &c., after their removal by decomposition. Sometimes, however, the moulds of shells and other fossils have been reduced to the character of imprints by the extreme pressure to which the strata containing them have been subjected. Casts are counterparts of fossils, having been produced by the filling of moulds with a substance other than that of the original fossil. These are the principal conditions in which fossils occur, or by which they are represented, but one occasionally finds specimens which indicate certain conditions that are not fully recognised in the foregoing descriptions.

[1] By Charles A. White. (Abstract of a series of eight essays published in the Report of the United States National Museum.)

SEDIMENTARY FORMATIONS, THEIR CHARACTER AND LIMITATION.

There has been much difference of custom among geologists as regards the use of the term formation, some applying it to the smallest assemblages of strata which possess common characteristics, while others designate by the same term those series of formations for which the word system has been generally used. That is, some apply the term formation to local or limited developments of strata, while others apply it to such systems as the Devonian, Carboniferous, Cretaceous, &c. This term has generally been confined to the stratified rocks, but by a few authors it has been applied to the eruptive, and also to the great crystalline, rock masses. In this paper, however, the use of the term formation is not only confined to the stratified rocks, but it is restricted to those assemblages of strata which have common distinguishing characteristics, whether they have little or great geographical extent, or whether they aggregate a few feet or thousands of feet in thickness. That is, the use of the term is confined to those assemblages of stratified rocks of sedimentary origin[1] to which many authors have applied the term group, and others the term terrane.

The foregoing remarks concerning the characterisation of formations have been made with special reference to those which are more or less fossiliferous. It sometimes happens, however, that fossils do not exist, or are not discovered, in certain formations which are evidently of sedimentary origin. This may have been due in some cases to the uncongeniality, as a faunal habitat, of the waters in which the formation was deposited, and in others to their failure to receive any fossilisable remains of animals and plants from the land. In other cases, the absence of fossils may have been due to their destruction or obliteration. The latter has probably been the case with many metamorphic rocks and with the great pre-Cambrian series of stratified rocks generally. In all these cases the formations, while they may possess more or less distinct physical characteristics, lack the chief characteristics of sedimentary formations, namely, the biological.

The occurrence of an unfossiliferous sedimentary formation as a member of an otherwise fossiliferous series is unusual, but in such a case its definition and limitation would be effectually accomplished by the underlying and overlying formations. In the case, however of a great unfossiliferous series of stratified rocks like the pre-Cambrian it is necessary to adopt a method for their study and classification based wholly upon physical data, after the fact that they are pre-Cambrian has been determined from biological data. Such a method of classifying and characterising those unfossiliferous stratified rocks as they occur in North America has been proposed by Prof. R. D. Irving[2] and afterwards elaborated by others. This great series of rocks, as it is developed in America, has such distinguishing general characteristics and such magnitude and geographical extent, that some geologists have thought it worthy of being assigned to a special division of study, but because no certain traces of organic forms have been discovered in them, they have, so far as it is now known, only the indirect relation to biological geology that has just been referred to. Still it is not improbable that those strata were once fossiliferous, and that the great series was once made up of formations similar to those which have been already defined, but it does not necessarily follow that the divisions which are now recognisable by physical characteristics correspond to those formations. It is probable that they more nearly correspond to systems or to the larger divisions of systems as they are recognised in the great scale of the fossiliferous rocks of the earth.

The following conclusions concerning formations are deducible from a consideration of the available facts:—

While formations are physical objects and have only a physical existence, their proper characterisation is chiefly biological.

They are characterisable mainly by the fossil remains of aquatic faunas.

Neither their physical nor biological limits are sharply defined except as a result of accidental causes.

Their geographical limitations are indefinite except those which were occasioned by shore lines.

[1] To avoid frequent repetition, the terms sedimentary formation and stratified formation are used interchangeably when applied to formations as defined above. The terms sedimentary rocks, stratified rocks, and fossiliferous rocks are also used interchangeably, but with a somewhat more general meaning than is intended by the two former terms.

[2] Irving, R. D.: "Classification of the Early Cambrian and Pre-Cambrian Formations." (Seventh Ann. Rep. U.S. Geol. Survey, pp. 371-399.)

They do not necessarily bear any close relation to one another as to geographical area, thickness, or the duration of time in their accumulation.

Although they are thus unequal to one another, they constitute the only available physical units for local or regional stratigraphic classification.

Because of their limited geographical extent they cannot be used as units of the universal classification of the stratified rocks.

THE RELATION OF FOSSIL REMAINS TO STRUCTURAL GEOLOGY.

There are two methods by which the study of fossils may legitimately be applied to geological investigation, and the following statement of the character of these is in part explanatory of the results that may be obtained by their aid. For convenience, one of them may be termed empirical and the other philosophical, because in the one case results are obtained by experience, and in the other by reasoning upon the various results thus obtained. Still, discrimination between these two methods cannot usually be sharply drawn, because, while all geological investigation is largely empirical, it is always more or less philosphical. Such a division of the subject, however, besides being a convenience, gives an opportunity to emphasise the fact that a large proportion of the work that is done in structural geology is based mainly upon the empirical observation and collection of biological data.

Both these methods are not only important but indispensable, the one not less so than the other. Both may be, and aften are, used together, but the empirical method is more largely used in practical field studies than in others, because in such studies fossils are to a large extent treated as characteristic tokens of formations, or as arbitrary means of identifying them and distinguishing them from one another. Such identification necessarily constitutes one of the first steps in the practical study of structural geology, but the subsequent study of the fossils thus empirically used is necessarily more philosophical.

The philosophical method of treating fossil remains, however, is largely applicable to systematic geology or those branches which pertain to the universal chronological classification of the sedimentary formations and to their correlation in different parts of the world. The naturalist studies fossil remains as representatives of the long succession of progressively and differentially developed organic forms which, during geological time, have existed and become extinct, and of which succession the now existing forms of life constitute only the terminal portion. It is the results of such studies as these that the geologist uses in the philosophical studies referred to.

Of the two ways in which formations are naturally characterisable, one is physical and the other biological. Physical characterisation may be direct or general, that is, it may be by identity of kind or kinds of rock of which the formation is composed, or by its possession of that more general or indefinite property or condition which indicates homogeny.

Formations are biologically characterised only by the fossil remains of animals and plants which lived while they were in process of deposition, and the more intimate the natural relation of any of those animals and plants to the physical conditions which produced a formation, the more characteristic of it are their remains. This implies that, while no kind of fossil remains is to be rejected in practical studies of structural geology, there is much difference in the value of the different kinds for this purpose. These differences in value will be specially discussed later on.

Much has been written on methods of distinguishing between formations of marine and non-marine origin, and the legitimate inferences that may be drawn from them, respectively, as to the physical conditions which prevailed while they were accumulating. It is desirable here to present some remarks upon the relative value in practical geological field work of the fossils found in marine and non-marine formations, respectively.

That the fossil remains of marine faunas are far more valuable as indicators of the chronological divisions of the geological scale and of the correlation of its divisions in different parts of the world than are those of non-marine faunas, is apparent to every one who is familiar with even the general facts of biological geology, but it does not follow, and it is not true, that the latter are intrinsically less valuable than are the former in field studies of practical geology. For this practical work, both marine and non-marine fossils are treated by the empirical method already explained, and both are found to characterise the respective formations in the same manner.

Certain conditions, however, give each an advantage over the other under different circumstances. For example, the geographical range of the non-marine invertebrate fossil faunas, especially those of fresh water, having been sharply defined by shore lines, the species which constituted them are to that extent more characteristic of the formations in which they occur than is the case with marine faunas. Certain species of the latter faunas, as already shown, usually ranged beyond the limits of the area which was occupied by each fauna as a whole.

Non-marine formations, as a rule, occur singly in a series of marine formations, in which case the vertical as well as the geographical range of their invertebrate species is sharply defined. It is true that in the interior portion of North America there is a continuous series of fresh-water formations, and that certain of the species range from one into another. These, however, are notable exceptions to the rule referred to, and they at most only make such non-marine faunas equal to the average marine fauna as regards exceptional vertical range of species. Again, non-marine formations usually have the advantage of the presence of remains of plants and of land vertebrates and invertebrates, which in marine formations are usually so extremely rare as to be unavailable.

On the other hand, marine faunas embrace such a wide diversity of forms as compared with the non-marine, and their progressive and differential evolution from epoch to epoch has been so much greater, that they offer as faunas much more abundant means for the characterisation and identification of formations. It is clear, however, that the opinion which some geologists have expressed or implied, that the fossil contents of non-marine formations are of little value in practical geological investigation, is not well founded. The following conclusions sum up the case :—

Formations being the only true units of local or regional stratigraphic classification, their correct identification is the first, and an indispensable, step in the practical field work of structural geology.

Although formations as such have only a physical existence, their biological characteristics are always the best, and often the only, means of their identification, and therefore the exhaustive study of fossils is of paramount importance in connection with all practical investigations of that kind.

The value of fossils in this respect is as purely practical as is that of any other aid to geological investigation, and it may be made available without reference to their great value in other respects.

Although all fossil remains are valuable for this practical use, those of aquatic faunas are more valuable than any others.

Remains of non-marine faunas are of similar value for this purpose to those of marine origin.

THE RELATION OF BIOLOGY TO SYSTEMATIC AND HISTORICAL GEOLOGY.

It has been made apparent in the preceding sections that each case of structural classification of stratified rocks based upon formations as physical units is independent of all others, and that its application is necessarily of limited geographical extent, because formations are themselves thus limited. It therefore follows that the structural geology of any district or region, embracing even an extensive series of formations, may be practically and thoroughly investigated, as regards both scientific accuracy and economic requirements, independently of that of any other district or region, especially of those regions which are not adjacent. It is now to be shown how the multitude of series of formations thus locally classified throughout the world have been grouped into a universal system of classification in connection with a scale having its divisions arranged in chronological order.

When the fossil faunas and floras which characterise each of a given series of sedimentary formations are compared with those which severally characterise the formations of the next preceding and succeeding series, and the whole are systematically compared with living faunas and floras, there is to be observed among those fossil forms, when studied through an unbroken vertical range of formations, an order of successive changes and modifications indicative of a general advance in biological rank, and also an indication of structural relationship. Furthermore, when the faunas and floras of a given series of formations are compared with those of other series in other parts of the world, it frequently appears that there is a close similarity between those of a certain portion of each series which indicates their correlation. In such cases an order of biological rank is to be observed similar to that which was observed in the original case. It also frequently occurs that the range of rank is found to be greater in one or both directions than is to be observed in other cases. By such means a knowledge of the order of faunal and floral, as well as of stratigraphical, succession far beyond that which could be obtained in any one region, has been acquired.

It is upon such empirical facts as these that the early geologists based their investigations concerning the chronological arrangement of the sedimentary formations of the earth, and the grand result of which was the adoption of a general scheme and the construction of a corresponding scale for their classification. This scale, which in its present condition is a masterpiece of inductive reasoning, necessarily originated in Europe, because it was there that geology was first systematically studied, and it is there also that its adaptation is more complete than elsewhere.

Although the scale now in use was established before the truth of the progressive evolution of organic forms was accepted by naturalists, and when all differences between those forms was believed to be due to special creations, general progression in average biological rank during geological time was perceived by the early geologists, as well as by those of the present day; but with them it was the perception of a progressive succession in rank of faunal and floral groups of great assemblages of organic forms, and not the recognition of the principle of evolution. Therefore they sought methods of explaining the facts and conditions which they observed with reference to the geological scale which they had established that should accord with the biological views which then prevailed, and which were largely of a supernatural character. Indeed, in the absence of the now prevalent natural method of explaining these facts, the supernatural method of the early geologists seems to have been necessary.

The following deductive propositions which now remind a naturalist of the articles of a creed more than of a statement of scientific principles, are presented as indicating the fundamental ideas held by the early geologists in connection with the construction of the geological scale, and as illustrating the state of prevalent opinion among leading geologists upon biological subjects in their time. It is true that no one author has ever published these propositions in the exact form in which they are here presented, but they have been formulated from the published utterances of numerous authors, and from personal recollections of an active participation in geological work during a number of years, immediately preceding the great revolution in methods of biological thought and investigation which has been referred to. These propositions are :—

(1) That every species of animals and plants, both living and extinct, was specially created, and that they are, and always have been immutable. That genera, and also the higher groups into which both the animal and vegetable kingdoms are systematically divisible, are categories of creative thought, and that they also are immutable.

(2) That although secular extinction of certain species, and even genera, occurred during every stage of the geological scale, at the close of each stage, except the Tertiary, all life upon the earth was simultaneously destroyed, and that at the close of each sub-stage life was at least in large part destroyed.

(3) That, at the close of each stage coincidently with, and the divinely ordained instrument of, the complete extinction of life, there was a universal physical catastrophe, and that the close of each sub-stage was, at least in part, physically catastrophic.

(4) That all life for each successive stage was created anew.

(5) That the life of each stage embraced specially ordained generic, or more general, types which were distinctive of and peculiar to it, and that their distribution was world-wide.

(6) That there was a special ordination of characteristic types for each sub-stage, which received world-wide and simultaneous distribution within its narrow time limits.

(7) That no identical, and few similar, specific forms were created for any two or more stages.

(8) That the world-wide distribution of the distinctive types of animals and plants which were ordained to characterise any stage or substage was effected in connection with the act by which their respective faunas and floras were created; or that in the case of species not having a world-wide distribution the typical integrity of faunas and floras was preserved by the introduction of representative—that is, closely similar—but distinct species.

(9) That by creative design the average biological rank of each new creation was higher than that of the next preceding one.

(10) That upon the fossilisable parts of the animals and plants which were created for each stage, and upon those designed to characterise each sub-stage, was impressed not only their own structural features, but recognisable evidence of their chronological ordination.

These propositions represent only those views of the pioneer geologists which pertain to biological geology. Other views which were held by them are unassailable, even in the light of the present advance of science, and their biological views are not introduced here for the purpose of disparagement, but to show that they gave origin to certain erroneous methods which are in part retained as an inheritance by some palæontologists, even though they ostensibly accept the principles of modern biology.

The foregoing propositions relate to what were regarded by the early geologists as fundamental ideas in the construction of the geological scale, while the following relate to those ideas which are now held to constitute its true basis because they only accord with natural laws. These are therefore essentially a counter-statement of the preceding propositions; but the principal object of their preparation is to point out the true relation of biology to systematic, historical, and correlative geology. They consist largely of the statement of certain of the principles involved in the theory of organic evolution, but they are by no means intended as a full statement of those principles, nor are they presented for the purpose of either discussing or defining them as such. That is, the statements are made not for the purpose of formally enunciating these principles, but for the purpose of making practical application of them to the subject in hand. Such of these have been selected for statement and comment as are believed to be accepted by all naturalists who admit the truth of organic evolution, and such application is made of them as will necessarily commend itself to all geologists who admit that truth and its applicability to biological geology.

These propositions are not intended to embrace the whole range of biological geology, but only such of its leading principles as are discussed in these essays. Therefore a certain lack of immediate relevancy will appear in the order in which they are stated.

(1) All species of animals and plants have originated genetically from pre-existing forms, and therefore all are more or less mutable as regards their reproduction. These, together with the various divisions higher than species into which the animal and vegetable kingdoms are divisible, have respectively acquired their distinguishing characteristics by differential and gradually progressive evolution. The extinction of all species and other divisions of the animal and vegetable kingdoms which has taken place during geological time, has always been by natural means and in accordance with natural laws. It has generally been secular and gradual, but in many cases locally or regionally accidental. No universal extinction has ever occurred.

(2) Coincident with the progress of evolution, notwithstanding the retardation, inertion, and even degradation that have occurred along certain lines, there has been during geological time a general average advancement in biological rank of animal and vegetable forms, evidence of which is afforded by certain characteristics of their fossil remains. The evidence of this general advancement constitutes the ultimate standard of measures of geological time as a whole, and the principal means of ascertaining the order of full succession of the events which attended the production of the stratified rocks of the earth.

(3) The chronological features which fossils possess are not of a special character as such, but they are among those upon which their biological classification is based, all of which features have resulted from both progressive and differential evolution.

(4) The average rate of progressive evolution for the different branches or divisions of both the animal and vegetable kingdoms has not been the same for each in all parts of the world, nor the same for all in any one part of the world, during all the time they have coexisted.

(5) The rate of differential evolution among the forms constituting certain divisions of the animal and vegetable kingdoms was greater than that among those constituting other divisions; and it was greater for some of the members of a given division under certain conditions than it was for other members of the same division under other conditions.

(6) The succession of gradual mutations, in the development of the leading classificatory features which characterise certain groups of fossil forms, was not necessarily concurrent with consecutive portions of time.

(7) The progress of secular extinction of species and other divisions of the animal and vegetable kingdoms, including the types which specially characterise the various stages and sub-stages of the geological scale, was accelerated by adverse changes of environing conditions, and were retarded by a continuance of congenial conditions. The final consummation of the extinction of the types was naturally often, and perhaps usually, caused by catastrophic changes of conditions which occurred within the limited areas to which they were reduced by approaching secular extinction.

(8) The geographical distribution of species within the time-limits of the stages and sub-stages of the geological scale, and consequently that of the distinguishing types which the species constitute, has been effected by natural means. Such means included not only locomotory and mechanical dispersion within those time-limits from one original centre which was then the terminus of an evolutional line, but, at least in the same cases, survival in various regions by separate evolutional lines from the faunas of preceding stages and sub-stages was also included.

(9) The animal and vegetable life of each stage of the geological scale was in the aggregate different as to its forms from that of all others, and each stage and sub-stage was further specially characterised by certain generic, and also more general, types or peculiar groups of species. These types, however, were not necessarily confined within absolute time-limits.

(10) Although movements and displacements of the earth's crust have from time to time occurred over large portions of its surface, arresting sedimentation or changing its character and causing great destruction of life, there has never been a universal catastrophe of that kind. On the contrary, during all the time that disastrous conditions prevailed in any given area, conditions congenial to the existence and perpetuity of life prevailed in other and greater areas.

The second of the two sets of propositions show that certain of the views held by the early geologists, notably those which assumed the universally sharp definition of all the divisions of the geological scale, were radically wrong. Still, it is evident to every one who is familiar with modern geological literature that those views have continued to exert an adverse influence upon the biological branch of geological investigation long after they have been formally rejected, even by those who continued to be influenced by them. The early geologists adopted methods of investigation which were consistent with their biological views, but it has been shown that from the present standpoint of biology certain of those views were so fundamentally wrong that the methods which were based upon them are quite out of place in modern investigation. Still, those methods of our energetic predecessors have come down to the present time with such force and with such evidence of the general correctness of the scale which they had established by them, that it has been difficult for their successors to adopt the modification of methods which has been necessitated by the great subsequent revolution in biological thought and methods of investigation.

The facts which have been stated show that, while the scale which the early geologists established is a wonderful production of human reasoning and the best possible general standard which can be adopted before a comparatively full investigation of the geology of the whole earth has been made, it is not, and cannot be except in a general way, of universal applicability. That is, while the respective stages and sub-stages of the scale are recognisable only by means of their characteristic fossil remains, it has been shown that any of those characteristic forms are so liable to range from one stage or sub-stage to another, that it is impossible to sharply define the limits of stages, and often impossible to distinguish sub-stages in one part of the world as they are known in another part.

(To be continued.)

SCIENTIFIC SERIALS.

Bulletin de l'Académie des Sciences de St. Pétersbourg, V[e] série, t. ii. No. 2, February 1895.—We notice in the proceedings of the meetings, that the full account of Baron Toll's observations in the New Siberia Islands will soon be published by the Academy. In the meantime the explorer has visited Switzerland in order to study glacier ice, and has found there further proofs, supported by A. Forel, in favour of the masses of ice which he has found in New Siberia (buried under clays containing fossil stems of *Alnus fruticosa* fifteen feet long), really being remains of the ice-sheet which covered the islands during the glacial period.—The yearly report of the Academy, which contains, among other matters, the obituaries of L. Schrenck, A. Middendorff, I. Schmalhausen, and P. Tschebycheff, whom the Academy has lost during the last year.—The positions of 140 stars of the star cluster 20 Vulpeculæ, according to measurements taken from photographic plates, by A. Donner and O. Backlund (in German). The measurements were taken on two plates, one of which had been exposed for twenty minutes only, and the other for one hour, and the accord between the two is most satisfactory, the average difference being 0·00s. in right ascension, and 0″·02 in declination, while the difference between the measurements on the photographic plates, and the direct measurements of Schultz, attains on the average $-0{\cdot}040$s. in R.A. and $-0''{\cdot}55$ in D.—On the differential equation $dy/dx = 1 + R(x)/y$, by N. Sonin.—On a new entoptric phenomenon, by S. Chirieff.—Note on the last mathematic conversation with P. L. Tschebycheff, about his rule for finding the approximate length of a cord, and the means of extending the method to curves of double flexure (all three in Russian).—The ephemeride of the planet (108) Hecuba, by A. Kondratieff.

Vol. ii. No. 3, March 1895.—Yearly reports of the Philological Section of the Academy, and of the committees: for the Baer premium, which was awarded this year to the Tomsk Professor Dogel, for his researches into the histology of the nervous system, and to Prof. Danilevsky for researches into the comparative study of parasites in blood, and the Lomonosov premium, which was awarded to A. Kaminsky for his work on the yearly march and geographical distribution of moisture in the Russian empire in 1871-90.—On the Perseids observed in Russia in 1894 (in French), by Th. Bredikhine. The observations were made by several observers at Odessa and at Kieff. It must be remarked that the observers have had difficulty in observing the meteors, the course of which made a sharp angle with the direction of the vertical line; and this circumstance is probably not without some influence upon the determination of the radiant point. The meteors observed on July 24, 26, and 27, seem to belong to a meteoric stream other than the Perseids. Combining the results of this year's observations (which are given in full in thirteen tables) with the observations of the preceding year, and calculating the elements for each of the radiants, the author sees in them a confirmation of the theoretical results he arrived at in his paper on the Perseids of 1893; the values of the inclination (i) of the centres of radiation—with the exception of the three first, which are somewhat uncertain—are all below the value of i for the comet of 1866. The average value of i before the epoch (August 10·5) is 60°, while after that time it is only 56°; but this decrease cannot be considered as quite real, on account of the said uncertainty in i for July 24-27. An inspection of the charts shows that a condensation of the radiation is taking place towards the epoch which falls on the night of the 10th to the 11th, as seen from the observations made in Italy by P. Denza. The arithmetical average of the coordinates of the three chief radiants of August 10 are $\alpha = 48° 48'$, and $\delta = 56° 30'$, we have: $l = 63° 32'$, $b = 36° 51'$, $i = 64°{\cdot}8$, $s = 72°{\cdot}8$, and $V = +34°{\cdot}4$. The value of i corresponds to the radiant of the comet of 1866. Considerable variations appear in the elements Ω and π; the perihelium is displaced in the direction of the orbital motion of the meteors. In a subsequent memoir the author proposes to take up the theory of the subject, and to evaluate the secular variations of the generating orbit of the comet, and of some of its derived orbits.—On the best means of representing a surface of revolution on a plane, a mathematical treatment of the subject, in Russian, by A. A. Markoff.—On the limit values of integrals, by the same.—List of the works of P. L. Tschebycheff.—On the methods for correctly determining the absolute inclination by means of the induction inclinator, and the degree of exactitude lately obtained with this instrument at the Pavlovsk Observatory, by H. Wild (in French).—The non-periodical variations in the quantity of precipitation at St. Petersburg, by E. Heintz (in Russian, summary in French).—Ephemeride of the planet (209) Didon, by Mme. Eugénie Maximoff.—Determination of the magnitudes of the stars in the star cluster 20 Vulpeculæ, by Mme. Marie Shilow. The diameters were measured by the micrometer, and the corresponding magnitudes were calculated by means of Charlier's formula.—On one sum, a mathematical note (in Russian), by I. Ivanoff.

THE numbers of the *Journal of Botany* for May to July contain, besides mere technical papers, one on the genu