the mentioned series. And here it is well to note that the defect of convergence does not arise from the application of the processes of integration, but already exists in the development of the perturbative function before integration commences. Thus Delaunay's development of this function at the beginning of his lunar theory is divergent and illusory, unless we have the lunar radius in apogee always less than the solar radius in perigee, and that without regard to the mode of expressing the coefficients. Some of the particular integrals relied upon by M. Poincaré to establish the vanishing of all the characteristic exponents, in case we accept M. Lindstedt's series as valid, lie, so to speak, on the boundary of the domain in which these series are convergent.

In the third place an appeal is made to the alleged non-existence of analytic and uniform integrals beyond those already known. Were this non-existence clearly established it would decide the question on the side where M. Poincaré has placed himself. But, at least as far as the non-existence of integrals of this nature in a limited domain for the linear variables is concerned, the proof given for it is quite defective. This proof consists in ascertaining how these integrals, supposing them to exist, would behave should we attempt to derive periodic solutions from them. It is difficult to present this matter without the assistance of algebraic formulas; nevertheless, it may be attempted. Let there be a number of equations whose left members are formed by the product of two factors. When we pass to a periodic solution, one of these factors becomes zero. What conclusion can we draw from each of the thus modified equations? Evidently one of two things: either the remaining factor of the left member is infinite and the right member indeterminate, or it is finite and the right member a vanishing quantity. Now in case we are obliged to accept the first conclusion, were it only but once, M. Poincaré has demonstrated the non-existence of integrals; but, granting that it is proper in every case to accept the latter conclusion, the demonstration fails. Now he declines to consider the latter alternative, saying that he does not believe that any problem of dynamics, presenting itself naturally, occurs where the right members of the mentioned equations would all vanish. But it should be borne in mind that, while they do not vanish in the general equations, the adjustment of the values of the linear parameters required by the passage to a periodic solution may bring about their vanishing. Thus, in the lunar theory, a periodic solution is brought about by making $e=0$, $\acute{e}=0$, and $\gamma=0$, the result is the vanishing of every coefficient having any of these quantities as a factor.

M. Poincaré appeals in another place to the fact that the Linstedt series, if convergent, would establish the non-existence of asymptotic solutions. But this observation is irrelevant for the reason that the domains of the two things are quite distinct. In any case where Lindstedt's series are applicable there are no asymptotic solutions, and where there are asymptotic solutions Lindstedt's series would be illusory.

We owe much to M. Poincaré for having commenced the attack on this class of questions. But the mist which overhung them is not altogether dispelled; there is room for further investigation.

G. W. HILL.

ADMISSION OF AMERICAN STUDENTS TO THE FRENCH UNIVERSITIES.

THE Conseil Supérieur de l'Instruction Publique has issued a decree removing the restrictions upon the admission of American and other foreign students to the French universities and giving them a status substantially similar to that accorded by the German universities. This important concession by the French authorities is the

direct result of a vigorous movement instituted by Prof. H. J. Furber, of the University of Chicago, who in the latter part of May, 1895, addressed to the Ministry of Public Instruction a memorial, calling attention to the appreciable increase in the number of Americans engaged in post-graduate work in Europe and the vastly greater percentage of foreign students at the German universities as compared with those of France. The memorial recited that at the Sorbonne there are but 30 Americans enrolled, while some 200 are at present in attendance at the University of Berlin, and in the smaller institutions of France and Germany the disparity is even greater.

Unless it be assumed, argues Mr. Furber, that France is intellectually inferior to Germany, the indisposition on the part of American students to avail themselves of the advantages offered by the French schools would appear to indicate either a failure to appreciate the unequalled excellence of the latter in many directions, or else some obstacle preventing the enjoyment of the opportunities which they afford. It is difficult to conceive, however, that our countrymen are without knowledge of the refinement of culture for which the French schools are so justly famous, and the inference seems conclusive that the scarcity of American students in France is attributable to the difficulties which beset the foreigner in gaining admission to their courses.

In Germany an American is allowed to matriculate and qualify for a degree upon the presentation of a bachelor's degree from some reputable institution of learning in the United States, and throughout his course is at liberty to elect the studies he may desire to pursue. He is free from examination, except when he chooses to apply for a degree, preparatory to which it is incumbent upon him to submit a satisfactory thesis upon some subject of original research in which he has been personally engaged. In fact, the only formalities required of the candidate for academic honors are the furnishing of credentials certifying to the proficiency of his early schooling, a certain minimum time spent at the universities of Germany, and a severe test of his abilities at the termination of his course.

In France, on the contrary, the student is subject to many rigorous restrictions which practically exclude the greater number of Americans. The bachelor's degree is not accepted as sufficient for entrance to many of the faculties, and the student is limited to an arbitrarily prescribed course of study and subjected to severe tests of progress at frequent intervals, depriving him in no small degree of his freedom of research and original investigation. Students from the United States are, with rare exceptions, men who have passed beyond the rudimentary grades of education and attained the rank of specialists. They are of intellectual maturity graduates of our universities and colleges, and are in quest not of discipline but of knowledge. They do not desire that any essential requirement in the French regulations be suspended, or that the grade of scholarship necessary either to matriculation or to graduation be lowered in their favor. They do insist, however, that the peculiarity of their purpose and position be duly considered, and that they be permitted to fulfill through some equivalent the requirements which, owing to the very nature of their case, are otherwise virtually prohibitive. The American student is not averse to the requirement of a somewhat lengthy term of residence in France, but he does maintain that he shall have the privilege of utilizing the period of study as he shall deem most profitable and most nearly in accordance with the plan which he has mapped out for himself.

On the 7th of June, Mons. M. Bréal, the eminent French educator and member of the Institute of France, published in the

Journal des Debats a resumé of Mr. Furber's memorial, which at once enlisted the sympathy of eminent French scholars, and resulted in a conference at the Sorbonne on the 26th of June, at which the Comité Franco-Américain was organized for the purpose of advocating before the proper authorities the desired changes in the French regulations. In July a committee styled the 'Paris-American University Committee' was also formed from among the Americans resident in Paris to coöperate with the Comité Franco-Américain, and at the invitation of Dr. Thomas W. Evans, Chairman of the Committee, a number of American and French gentlemen interested in education assembled at his residence in Paris for the purpose of deliberating upon the most practicable course to be pursued to bring about the desired reforms. Addresses were made by Mons. Bréal, Chairman of the Comité Franco-Américain, Prof. Furber and others, and the various difficulties relative to matriculation and graduation in the French universities were thoroughly discussed.

Shortly after the formation of the Paris-American Committee, Prof. Simon Newcomb, at the solicitation of Prof. Furber, organized in Washington an American committee to coöperate with the Comité Franco-Américain and to give authoritative expression of the sympathy of the people of the United States in the movement. The Committee numbers among its members Prof. Newcomb, Chairman; Dr. S. P. Langley, Secretary of the Smithsonian Institution; President Charles W. Eliot, of Harvard University; Hon. Andrew D. White; President Timothy Dwight, of Yale University; President D. C. Gilman, of Johns Hopkins University; Hon. W. T. Harris, U. S. Commissioner of Education; President Seth Low, of Columbia College; Hon. Carroll D. Wright, U. S. Commissioner of Labor; President J. B. Angell, of the University of Michigan; President J. C. Schurman, of Cornell University; Prof. E. R. L. Gould, Secretary of the International Statistical Association; President B. L. Whitman, of Columbian University; President G. Stanley Hall, of Clark University; and G. Brown Goode, Assistant Secretary of the Smithsonian Institution, who acted as Secretary. A meeting of the Committee was held at the Columbian University on November 13th at which resolutions were adopted expressing the sense of the committee that America would heartily welcome the proposed changes in the French regulations, and suggesting, as a means of inducing American students to avail themselves of the precious advantages offered by the well-organized system of university instruction of France, that the French authorities accept the bachelor's degree as the equivalent of that of the Freneh Lycèe, and that owing to the lack of familiarity with the French language, the frequent rigorous examinations required by the French system be dispensed with in the case of foreign students. The committee strongly opposed the suggestion of establishing a degree for Americans only, which should have less significance than that conferred upon native students. These suggestions were elaborated by the French committee, presented to the Ministry of Public Instruction, and defended by the committee before the Conseil Superieur. After due deliberation, the latter body, on the 17th of January, voted a decree introducing into the French faculties of science all the best features of the German system. In accordance with the decree, a student will hereafter be admitted to these faculties on an American bachelor's degree, and will be permitted to choose his studies. After pursuing any scientific course for a year, he can, if he wishes, apply for an examination in this branch and, if successful, obtain a *certificat d'ètude*. Three such certificates

will entitle him to a *licence-ès-science*, and upon the presentation of a satisfactory thesis he will be eligible to the French doctorate. If he has the ability, he can, at his pleasure, discharge all three subjects in one year; or he can do so in successive years, migrating, if he wishes, from one university to another, and studying at the same time whatever other subject he may choose.

The French system as modified possesses one distinct advantage over that of Germany. In the latter country the student must present his thesis before he is admitted to examination for the doctor's degree, and if he fails to present a satisfactory dissertation he is without a degree or diploma. In France, however, the examination precedes the presentation of the thesis, and the student receives independent credits for every portion of his work. If he acquits himself in one branch only, he has his certificate, three of which, as has been explained, give him the *licence-ès-science*. If interrupted in his work before securing a degree he may withdraw with honorable credentials for at least that portion of his work which has been accomplished.

The degree rendered by the Conseil has reference only to the faculties of science. It is hoped, however, that a similar arrangement may be had in the Department of Letters. Important concessions have already been made in connection with the admission of American students to the faculties of medicine, and Mons. Bréal, in a letter to Prof. Furber, writes that the Faculty of Protestant Theology manifests a most liberal disposition in this regard. The changes which the French have made are of very great value. It now rests with the students of America to manifest their appreciation and to avail themselves of the facilities which are placed within their reach, in the same warm spirit in which they are offered.

G. Brown Goode,
Secretary of the American Committee.

APPLICATION OF THE X-RAYS TO SURGERY.

The manifold uses to which Röntgen's discovery may be applied in medicine are so obvious that it is even now questionable whether a surgeon would be morally justified in performing a certain class of operation without having first seen pictured by these rays the field of his work, a map, as it were, of the unknown country he is to explore. It may be well to consider first what has already been accomplished in this direction, and then briefly to enumerate a few achievements we may expect when the time of exposure is lessened, the intensity of this form of radiation increased and, possibly, the rays brought to a focus.

Mosetig, of Vienna, was the first to make a practical application of the new discovery in surgery. The case was one of double phalanges at the tip of the big toe. It was impossible, by the usual means of diagnosis, to decide which of these bones communicated directly with the middle phalanx, thus forming the joint, and which was the supernumerary bone. It was, therefore, deemed advisable to amputate at the distal articulation, but a picture secured by the Röntgen process revealed very clearly that one of the phalanges formed a portion of the true joint, the other being merely connected therewith by means of an osseous union. It was then a very simple matter to remove the extra phalanx, the surgeon having before him a complete picture of the osseous parts involved. The satisfaction of the patient may also be imagined, for he could see for himself the advisability and simplicity of the operation. The next case of Mosetig was one in which a bullet had lodged in the fifth carpal bone and there become encysted. Various means had been previously tried, but unsuccessfully, to locate the bullet. In the picture in this case may also be noticed a sessimoid bone; and here attention should be called to the fact that these extra bones should not be mistaken

for foreign bodies. Neusser's experiments were made upon objects outside of the body, and of these the first telegraphic newspaper reports were most confusing, many persons being lead to believe that a calculus had been photographed within a kidney in the living subject. Prof. Neusser was able to obtain a distinct picture of a phosphatic vesical calculus through four centimeters of calf's liver. Haschek and Lindenthal have shown the fibrous bands uniting old injured bones. Having injected the arteries in the hand of a cadaver, they have shown a method of making a plate which will be useful for anatomical instruction. Lannelongue, of Paris, has diagnosed by this process tuberculous arthritis. Cox, of Montreal, early in his investigations, secured the picture of a bullet in the calf of the leg; the bullet, which was afterward removed, being located between the tibia and fibula. Buckshot has been found by Pupin; needles and glass have been pictured by several observers and afterward removed. Robb, of Trinity, diagnosed a luxation and fracture in the hand of a patient who was under treatment for another condition. Röntgen has recently prepared a picture of a fracture of the forearm with much displacement. Lodge has a picture showing a bullet in the wrist. Of the tissues of a cat, Reid finds bone the most, and cartilage the least, opaque. It is reported by the *Lancet* that a thigh bone attacked with osteomyelitis has been pictured. A skiagraph of a suppressed and a rudimentary phalanx is shown in the *Boston Medical and Surgical Journal* of February 20, 1896. The writer has been able to discover in a living subject a doubling of one of the carpal bones and those of the corresponding first row of phalanges, in a case of polydactylism, with webbed fingers. The same picture also showed osseous union at the tips. In another case ankylosis of the terminal and middle phalanges of a finger is seen. And so the list might be increased by observations made throughout the civilized world, as wherever these experiments have been repeated physicians have naturally seized upon the opportunity to benefit the patient.

Carbutt, of Philadelphia, suggests that celloidin films may be moulded to the contour of the body, thus facilitating the taking of a picture of the thicker portions of the arm, the leg, or the trunk. He is also preparing plates which will be peculiarly suitable to the action of this form of energy.

In conclusion, let me cite a few of the many instances in which this discovery may be useful in medicine and surgery. First. In the diagnosis of luxations and fractures, at times a difficult or impossible procedure, it will be possible, in certain cases, to picture a fractured bone, reduce and dress it, and afterward secure a skiagraph through the bandages, thereby demonstrating beyond doubt whether there has been proper approximation of the ends of the bones. Again, it may be practicable to fix the time at which union has taken place, and to determine accurately the amount of osseous deposit that has occurred on the bone, it being a well known fact in surgery that this union takes place in a longer or shorter time, depending upon age and individual peculiarities. The distortion of bones when pictured upon different planes might doubtless be overcome by the use of mirrors, or other apparatus.

Second. Certain foreign bodies, as glass, bullets and needles, may be diagnosed not only in the extremities, but in other parts of the body. A jackstone lodged in the larynx, or a set of teeth, penknife, coin, intubation tube, etc., in the intestinal tract might be revealed by a careful study of the plate. Renal and urinary calculi may possibly be located under favorable conditions.

Third. It may be possible to distinguish in certain cases an adulterated from unadulterated drug, *e. g.*, some tinctures permit the

rays to pass much more readily than others. Flaws in instruments, especially those made of aluminum, might be detected by these rays. Experiment alone will decide whether bacteria will be influenced by the rays in the same manner as certain colonies of organisms are injured by exposure to the direct action of the sun. Park, of New York, has exposed a culture of the diphtheria bacillus for thirty minutes to the rays from a Crookes tube without any result being noted. He who is able to secure a picture of the brain will accomplish more than can be expected from the present state of our knowledge of the X-rays.

The suggestion has been made that in our large cities skiagraphic institutions should be erected and equipped, to which physicians or surgeons could send patients, and where, under their direction, pictures of the desired portion of the body could be prepared, just as a physician now writes a prescription which is sent to the druggist to be compounded. Our large hospitals where numerous accident cases are brought should have in the near future a plant sufficient to prepare skiagraphic reproductions at short notice.

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CURRENT PROBLEMS IN PLANT MORPHOLOGY.

ON SOME CHARACTERS OF FLORAL GALLS.

The growing interest in ecology which is so marked a feature of botanical investigation during the last five years has occasioned new and valuable work on galls, so that now for the first time compendious works have begun to appear, in which a really scientific and adequate account of these curious structures is attainable. An excellent resumé in popular style is that given in Kerner and Oliver's *Natural History of Plants*, Vol. II., pp. 518–554. That upward of 1,600 different kinds of galls have been described is noted, and an attempt is made to classify them. With characteristic looseness Kerner divides galls into fungus galls and insect galls, but this is quite inadequate, for algæ, among plants, also produce galls, *e. g.*, Phytophysa treubii W. v. B.,* which attacks the leaves of Pilea at Buitenzorg. And "insects," under which Kerner includes Arachnoidea, are not at all the only gall-producing animals, for nematodes (afterwards mentioned by Kerner) and rotifera are well known as efficient causes in cediciogenesis.

Kerner's classification of galls from a plant anatomical point of view is, however, excellent and is reproduced with some slight modifications in Ludwig's *Lehrbuch der Biologie der Pflanzen.*† Fundamentally galls are either simple or compound, as one or several organs take part in their production. Each class is divided into a number of subclasses, but the details need not be gone into here. The account given by Ludwig is compact and clear.

The changes produced in flowers and inflorescences when they are subjected to stimulus from a cecidiogenic organism may be classified as: 1. Chlorosis. 2. Multiplication of parts. 3. Metamorphosis of parts. 4. Suppression of parts. 5. Hypertrophy, general or restricted. 6. Antholysis. 7. Fusion of parts. 8. Fasciation. Examples of these are as follows: 1. Green flowers of Veronica. 2. Double flowers of Rhododendron. 3. Flowers of Valerianella in which petals are substituted for stamens. 4. Flowers of Anemone nemorosa inhibited by *Puccinia fusca.* 5. Flowers of Lychnis in which a parasitic Ustilago stimulates the growth of the vestigial stamens of pistillate flowers until they rival in structure the normal stamens of staminate flowers. 6. Flowers of gentians in which the carpels

* Weber: Zoolog. Erg. Reis. Niederl. Ost-Ind. Hft. I. 48–71. Leiden, 1890.

† Ludwig: l. c., pp. 98–110. 1895.