charge of Dr. H. H. Field, of Zurich. It was suggested at the conference that these should be taken into account in fixing the form which the International Catalogue should take in the future.

The immediate problem, then, is to secure the indexing of the scientific literature published during the war. While this is being done, arrangements can be made for the efficient continuation of the work of cataloguing the scientific literature of the world.

The International Congress of Mathematicians.

THIS congress was opened at Strasbourg University on September 22 by the Rector, M. S. Clarety. The officers of the congress were then elected as follows:—*Honorary President:* M. Camille Jordan. *President:* M. Emile Picard. *Vice-Presidents:* Prof. Leonard Dickson, Sir Joseph Larmor, Prof. Nörlund, M. de la Vallée-Poussin, M. H. Villat, and M. Volterra. *Secretary:* M. Koenigs.

The delegates numbered 188 and represented 26 nations, amongst which may be mentioned Argentina (4), Australia (1), Brazil (1), Canada (1), Czecho-Slovakia (12), India (2), Japan (2), the Philippine Islands (1), Poland (4), Russia (1), and Serbia (2). The expenses of the congress, including the publishing of the proceedings, have been completely provided for. Of the sum required, 78,000 francs was contributed by public bodies, by industrial and commercial concerns, and by private persons. An interesting fact is that the French Government made its contribution of 10,000 francs through the Ministry of Foreign Affairs, thereby recognising, it would appear, that such a congress has a certain significance in international politics. The subscriptions of delegates produced a further sum of 12,000 francs.

On Thursday, September 23, a general lecture was given by Sir Joseph Larmor on "Questions in Physical Indetermination." Sir Joseph said that of the three physical deductions upon which the validity of Einstein's theory depended, the two which had been verified by experiment, namely, the motion of the perihelion of Mercury and the deflection of light-rays by the sun, could be made to result equally well from a theory involving an æther. But the third Einstein prediction, the displacement of solar spectral lines, was inconsistent with any æther theory. In his opinion, it would be found, when conclusive observations had been made, that the third prediction was not verified. The doctrine that the universe is completely "full" originated with Descartes. The same doctrine was held by Newton, Huygens, Faraday, Fresnel, and Maxwell, but as a much more precise conception. The vortex theory and the elastic solid æther theory had had their day, but there was no reason at present why we should not admit the existence of an æther—a new æther the properties of which were so different from those of ordinary matter that they could be expressed only in terms of non-Euclidean space. The alternative was complete abstraction, the absence of a basis on which to found our theories. The essence of Newtonian space, as enunciated in the works of Lie and Helmholtz, was the possibility of the existence of rigid bodies in motion. Newtonian space was the space of mechanics, for which $dx^2+dy^2+dz^2$ was invariant.

For Faraday and Maxwell, on the other hand, radiation was fundamental. The characteristic of Maxwellian space was *complete transmission.* A pulse travelled without change of form and without leaving anything behind—a principle that was in accord with experiments in light. This was the space of Minkowski, for which the corresponding invariant expression was $dx^2+dy^2+dz^2-c^2dt^2$.

As with Sir Joseph Larmor, so with most of the other contributors to the subject of relativity, the endeavour was directed towards the elimination of those paradoxes which the human mind finds it difficult to accept rather than towards the further development of the theory itself. Thus M. Guillaume, setting forth from the remark that in the theory of relativity we were dealing with the apparent positions of bodies and that the difficulties of the theory arose from the fact that their "real" positions were supposed unknown, offered an alternative analysis in which the initial "real" positions of bodies were supposed known. He obtained results in which some of the paradoxes disappeared. M. Guillaume stated, however, that he had been in correspondence with Prof. Einstein, and had not been able to bring about a reconciliation of the two points of view.

The second general lecture, on "Relations between the Theory of Numbers and other Branches of Mathematics," was delivered on Friday, September 24, by Prof. Leonard Dickson, of Chicago. Prof. Dickson showed how the problem of obtaining rational solutions of certain classes of homogeneous equations was connected with the known properties of certain surfaces and with the theory of hypercomplex numbers.

In a lecture on the teaching of mathematical physics M. Volterra said that what might be called "analytical physics" now constituted an integral whole. Newton had reduced the problem of the universe to a problem in ballistics, and upon this basis Lagrange had founded his analytical mechanics. In a similar way the constitution of matter was for the modern physicist a problem in electricity, and we awaited a new Lagrange. At the present time there were two distinct methods of teaching mathematical physics in universities. The first might be called the *monographical* method. The student followed in succession separate courses in hydrodynamics, optics, and so on. The weakness of this method was that there was no grasp of the subject as a whole. In the other method the student started with a course of mathematical analysis, and, so equipped, he proceeded to the various branches. The fault here was that in the first part of the course he was working without seeing his objective; he did not understand the purpose of his work or see its special difficulties. The course that M. Volterra advocated consisted of three parts. The first, on more or less historical lines, carried the student as far as the general equations. The second part was a discussion of those equations, including a classification of them according to their characteristics and a classification of the problems according to the methods of solution. The third part was the solution and discussion of specific problems. This scheme left for separate treatment those portions of analytical physics which depended upon the calculus of probability, as well as thermodynamics and some minor branches.

M. de la Vallée-Poussin in his lecture, "Sur les fonctions à variation bornée et les questions qui s'y rattachent," dealt with the fundamental theory of integration in the light of Baire's classification of functions. All classes of functions (Baire) are integrable in the sense of Lebesgue. Stieltjes's integral

$$\int_a^b f(x)d\alpha(x)$$

can be defined by the process of Lebesgue, and it exists for all Baire functions f. The functional U(f) (Fréchet and Volterra), which has an assigned value for each of the elements f of a set, can be transformed into a Stieltjes integral. By making use of the univocal correspondence, established by Peano, between the points interior to a rectangle and the points on a segment of a line, functionals depending upon two arbitrary functions can also be reduced to simple Stieltjes integrals.

The subject of the fifth lecture, which was given by Prof. Nörlund, of Copenhagen, was "Les équations aux différences finies." The lecturer gave a very complete discussion of the solutions of equations of the types

$$\tfrac{1}{2}\{\phi(x+\omega)+\phi(x)\}=f(x), \quad \tfrac{1}{\omega}\{\phi(x+\omega)-\phi(x)\}=g(x).$$

In an interesting communication Prof. W. H. Young proposed a new definition, which does not involve an approximation by means of tetrahedra, for the area of a curved surface. The proposal is, first, to define the "area of a curve" as the square root of the sum of the squares of three integrals of the form

$$\int ydz-zdy.$$

Then, the surface being determined by the equations

$$x=f_1(u, v), \qquad y=f_2(u, v), \qquad z=f_3(u, v),$$

suppose the domain of u, v to be divided up into elementary rectangles in the u, v plane. The area of the surface is the limit of the sum of the areas of the corresponding elementary curves.

Prof. Weiss, the director of the Strasbourg Institute of Physics, gave an account of the methods of sound-ranging in use in the French Army during the war. The method normally employed was the same as that in use in the British Army. A useful alternative was the method *à courtes bases,* in which six or more microphones were placed in pairs. The microphones of each pair were about a hundred metres apart, so that the gun locus became a straight line (asymptote), and at once gave the direction of the hostile gun. The installation was very simple, and could be made in an hour, while single sets of observations could be reduced and reported in a minute. This method was used, not for the accurate location of gun emplacements, but for determining quickly which one of the known hostile batteries was in action. Guns were also successfully located by observations of the *onde de choque*. The normals to this wave-surface determine a caustic which is nearly constant in form for high-velocity shells. To locate the gun emplacement, a standard caustic drawn on tracing-paper was fitted by trial to the normals determined by the instruments. This method was used when atmospheric conditions made the spherical wave imperceptible, and, although less accurate, it gave very good results. A case was quoted where 80 per cent. of the hostile emplacements were correctly located solely by *ondes de choque*.

In the course of the congress receptions were held by the Committee of Organisation, the Société des Amis de l'Université de Strasbourg, the Mayor of Strasbourg, and the Commissaire Général (M. Alapetite).

At a concert organised by the Société des Sciences du Bas-Rhin, the delegates had the pleasure of hearing *'s Elsasslied* sung by the mixed choir of the Concordia-Argentina Choral Society. The delegates were entertained at the conclusion of the proceedings at a banquet given by the Organising Committee.

The invitation conveyed by Prof. Leonard Dickson to hold the next congress in New York in 1924 was accepted, and a further invitation was received to hold the congress of 1928 in Belgium. H. B. H.

Disorders of Symbolic Thinking.

DISCUSSION AT THE CONGRESS OF PHILOSOPHY AT OXFORD.

SEVERAL subjects of direct scientific interest were discussed at the Congress of Philosophy held at Oxford on September 24–27. One of the greatest importance, because based on recent clinical and experimental research, was the discussion introduced by Dr. Henry Head in a paper entitled "Disorders of Symbolic Thinking due to Local Lesions of the Brain." It raised the whole problem of the relation of language to thought while concentrating attention on the significance of certain definite observations—cases of young men who had received cerebral injuries in the war—in which the injury to the brain had affected the power of articulation.

Dr. R. Mourgue, of l'Asile de Villejuif, also contributed a paper, and was announced to take part in the discussion. He was unable to be present, however, and his place was taken by Prof. Bergson.

Dr. Head said that his general conclusion from the cases he had studied experimentally, where gross destruction of brain-tissue had resulted in loss of speech, was that there always remained elements in thought which were not associated with words. Speech is a discriminative movement capable of fine degrees of adjustment, essentially an intellectual mechanism. Even in the gravest cases of aphasia the patient is evidently fully aware of his emotions, and can express them clearly in gesture and action. Under the influence of emotion he may even use words or phrases which he is quite impotent to evoke voluntarily. Speech can be disturbed, or even totally lost, without reducing the patient's intellectual capacity or of necessity producing grave intellectual defect. All the early work of investigation of aphasia had been vitiated by the conception that speech was a well-defined intellectual function, strictly localised in some particular site in the brain. Attention was concentrated, therefore, on correlating the extent of anatomical destruction on this site with the character of the disorder of speech. The fundamental error at the root of all this work is its ignoring of the physiological changes which intervene between the anatomical lesion and the psychical states with which it is associated. Destruction of the substance of the brain disturbs the act of speech only because it interferes with the physiological processes necessary for its perfect execution.

Dr. Head then described the nature of his experiments and the means he had devised to discover the physiological processes with which the particular injuries had interfered. In the older theories auditory images were supposed to be responsible for "memories" of words, and these were said to be stored up in certain areas of the cortex. The hypothesis is entirely unable to explain the phenomena of aphasia. Patients who cannot name consecutively a series of objects in front of them can choose them correctly when the name is given either orally or in print. It is the name, not the auditory image, which is lacking. The loss of the power to use words is not due to a destruction of images.

What, then, Dr. Head asked, are the functions which are disturbed in aphasia? The true answer had been given so long ago as 1868 by Hughlings Jackson, though its significance was not then seen. The chief mental activity disturbed by unilateral lesions of the brain was declared to be the use of words in proposi-