gave the results of an experimental investigation by means of india-rubber models. The following are some of the conclusions given :—(1) Tensile stresses may exist at the up-stream toe of a dam, notwithstanding the fact that the line of resistance lies well within the middle third. The tension may be reduced by (*a*) making the up-stream face vertical, or by otherwise increasing the weight of the dam toward that face; this would have the effect of increasing the stresses in the dam when the reservoir is empty; (*b*) by a general increase in the dimensions of the dam; (*c*) by placing an earth embankment against the down-stream face. (2) The direct stresses at the down-stream toe are compressive in every direction, but reduce to zero in the direction normal to the face. (3) The maximum compressive stresses in a dam above its foundations are in a direction approximately parallel with the down-stream face, and generally some distance therefrom. In magnitude they are slightly greater than

$$\frac{P_T}{\cos^2\phi},$$

where $P_T$ is the maximum normal pressure on a horizontal plane as determined by the trapezium law, and $\phi$ is the angle between the resultant and the vertical. (4) The shearing stresses are considerable at or near the up-stream toe. They are a maximum a short distance from the down-stream face, in a plane approximately at 45° to the face. The maximum shearing stresses are in magnitude equal to

$$\frac{P_T}{2\cos^2\phi}.$$

(5) The stresses in the foundations are of less consequence than in the dam above the base, because of the lateral support and the more extended distribution. (6) The stresses are considerable at the toes of a dam if they form sharp angles with the foundations. These stresses may be reduced by replacing the angles with curves of large radii. The curve at the up-stream toe may take the form of a rounded quoin, cut in large stones, so as to avoid joints, in the masonry, normal to the direction of the greatest tensile stress.

In the third paper Mr. E. P. Hill described a method of determining stresses based on the assumption that the vertical pressure on the base varies uniformly from one side to the other.

## AUSTRIAN SCIENCE.

THE monthly parts of the *Sitzungsberichte* of the Vienna Academy of Sciences which appeared last year show that there is no falling off in the research work carried out at the Austrian universities in the fields of mathematics and natural philosophy. Prof. Lecher, of Prague, has verified Ohm's law by showing that there is no difference in the resistance of a silver or platinum wire when a small or a large electric current passes through it, provided its temperature is the same in both cases. Assuming that the current is carried by one type of free electron, he deduces a velocity of propagation of electricity in ordinary cases of the order of a few centimetres per second.

Prof. F. Exner and Dr. E. Haschek have been eagaged in a search for the cause of the slight variability of wave-length of many of the spectral lines with the method of excitation. They are disposed to attribute it to the lines for which it has been observed being complex, with satellites of variable intensity or number which appear to be present more frequently on the red than on the blue side of the line. In an instrument of only moderate resolving power, the apparent effect of any cause tending to increase the intensity of such satellites with respect to the original line will be a displacement of the line towards the red end of the spectrum.

Dr. N. Stücker has investigated the sensitiveness of a great number of persons to small differences of pitch in different parts of the musical scale. He finds that in general the region of maximum sensitiveness is in the octaves $c^1$ and $c^2$, where about 1/20th of a tone can be detected. A few musical people were able to detect a difference of 1/200th of a tone in this region. The higher limits of audibility varied from about 40,000 in general to more than 60,000 in the case of musicians.

The meteorological side of the activity of the academy is well represented by Dr. F. M. Exner's outlines of a theory of variation of atmospheric pressure. The principal result of this investigation is that the pressure variations may be represented by the motion of a relatively permanent system of isobars over the surface of the earth from west to east with a velocity varying slightly with the season.

An important series of papers by Prof. Rudolph Wegscheider and Dr. Heinrich Walter, published in the *Sitzungsberichte* (vol. cxvi., pp. 443, 455, and 533), throws a great deal of light on the phenomena occurring when soda is causticised by means of lime. On the one hand, the conditions of equilibrium for the reversible change $Ca(OH)_2 + Na_2CO_3 \rightleftharpoons CaCO_3 + 2NaOH$ have been ascertained at different temperatures; that the change is a reversible one is shown by the fact that the same condition of equilibrium is established at a definite temperature whether the lime acts on sodium carbonate or caustic soda on calcium carbonate. The change in the direction from left to right seems to be more complete at 80° than at 106°–110°, and to occur more readily in dilute than in concentrated solutions; the way in which it is influenced by concentration is considered at some length from the standpoint of the theory of mass action. The loss of sodium carbonate which may occur in the more concentrated solutions owing to the formation of the mixed carbonate, $CaCO_3,Na_2CO_3$, is also fully dealt with, the conditions under which gaylussite, $CaNa_2(CO_3)_2,5H_2O$, and pirsonnite, $CaNa_2(CO_3)_2,2H_2O$, are capable of existence in contact with solutions of sodium carbonate and caustic soda being defined for different temperatures. It is noteworthy that the decomposition of both of the double salts by water is retarded owing to the formation of a protective sheath of insoluble calcium carbonate on the surface of the particles, so that if the mixed salt is once precipitated owing to the concentration becoming too great, loss of sodium carbonate may occur even though the insoluble material be well washed. The whole investigation has a special interest as illustrating the applicability of recently developed views in pure chemistry to the elucidation of technical problems.

During several years past the study of the general laws of esterification, especially of the influence exercised by structural peculiarities on the phenomena, has formed a special feature of the research work carried out under the direction of Prof. Wegscheider in the first chemical laboratory of Vienna University. The results obtained have, in particular, thrown considerable light on the nature of the so-called "steric hindrance." In continuation of these researches a series of papers by Anton Kailan appears in the *Sitzungsberichte* of the academy dealing with the esterification of the dinitrobenzoic acids, of mono- and di-hydroxybenzoic acids, and of pyridinemonocarboxylic acids by alcoholic hydrogen chloride. Prof. Wegscheider and E. Frankel discuss in considerable detail the reasons for abnormalities which sometimes are found to characterise the action of alkyl haloids on metallic salts of organic acids. The peculiar influence exercised by the presence of a small proportion of water on the rate of formation of ethyl chloride from alcohol and hydrogen chloride is the subject of a paper by A. Kailan, in which it is shown that the velocity constants of the action are proportional to the concentration of the hydrogen chloride only in absolute alcohol. In alcohol containing water, even in 99·9 per cent. alcohol, an increase in the concentration of the hydrogen chloride is found to be accompanied by a considerably greater increase in the velocity constant.

To vol. cxvi. of the *Sitzungsberichte* (*mathematisch-naturwissenschaftliche Klasse*) of the academy Mr. F. Siebenrock contributes a monographic revision of the American tortoises of the family Cinosternidæ, in which several changes in the generally accepted classification are proposed. In the British Museum Catalogue of Chelonians the family is taken to include only the single genus Cinosternum, while Claudius and Staurotypus are included with Dermatemys in the family Dermatemydidæ. This the author regards as an unnatural arrangement, and he proposes to transfer Claudius and Staurotypus to the Cino-

sternidæ, in which they form the subfamily Staurotypinæ. Mr. Siebenrock goes, however, even further than this, and suggests that the Cinosternidæ should be brigaded with the Chelydridæ in one sectional group—the Chelydroidea; while the families Dermatemydidæ and Platysternidæ are regarded as more nearly related to the Testudinidæ, with which they should form the group Testudinoidea. For the structural details on which the author justifies this radical change in taxonomy, reference must be made to the paper itself.

Morphologists will find much to interest them in an article in the same volume by Mr. Max Holl, of Graz, on the anatomy of the hind portion of the cerebral lobes in man and apes. The author appears to have been led to undertake the investigation by finding one human brain which differed most remarkably in regard to the arrangement and complexity of the postero-lateral sulci from all others which had come under his observation. His studies have, however, shown that there is a great amount of variation in this respect in human brains, and he has in consequence been led to recognise two principal types. To the more primitive of these he gives the name pithecoid and to the other that of anthropoid, type. Between the two there exists, however, an almost complete gradation. By far the greatest degree of individual variation in the form of the postero-lateral region of the brains of Primates occurs in the case of the tropical American spider-monkeys of the genus Ateles.

Attention may likewise be directed to a paper by Dr. Karl Byloff in the same volume on the structure and life-history of the blood-parasites *Trypanosoma lewisi* and *T. brucei*. New methods of staining microscopic preparations have enabled the author to bring to light certain previously unknown features in connection with these organisms. The various developmental stages assumed by trypanosomes in mammalian blood are the result of division of adult forms. High magnifying power has revealed the presence of pseudopodia-like projections at the "hind extremity" of both species of trypanosomes, but whether these are constant morphological features or merely temporary developments has yet to be demonstrated.

## *THE CENTENARY OF DAVY'S DISCOVERY OF THE METALS OF THE ALKALIS.*[1]

A HUNDRED years ago last October, there happened one of those events to which the term epoch-making may, without cavil or question, be fittingly applied.

As it was an occurrence with which the name and fame of the Royal Institution are inseparably bound up, the managers have thought it only proper that its centenary should not pass unnoticed here, and it is by their wish, therefore, that I appear on this the first possible opportunity after the actual date of its hundredth anniversary to give you some account of it, and to state, so far as I am able and within the limits of an hour, the fruitful consequences that have flowed from it.

Let me, in the first place, attempt to recall the circumstances which led up to that cardinal discovery of which to-night we celebrate the centenary. These are connected partly with the institution itself and partly with the state of science in the early years of the nineteenth century.

In the year 1807 this institution was entering upon the eighth year of its existe ce. As you doubtless know, the Royal Institution grew out of a proposal to deal with the question of the unemployed, namely, by forming in London by private subscription an establishment for feeding the poor and giving them useful employment, and also for furnishing food at a cheap rate to others who may stand in need of such assistance, connected with an institution for introducing and bringing forward into general use new inventions and improvements, particularly such as relate to the management of heat and the saving of fuel, and to various other mechanical contrivances by which domestic comfort and economy may be promoted. Such was the original prospectus, but, like many other prospectuses, it failed to equal the promise its projectors held out.

[1] A lecture delivered at the Royal Institution of Great Britain, on Friday, January 17, by Prof. T. E. Thorpe, C.B., F.R.S.

Eventually the promoters decided, on the initiation of Count Rumford, that the Associated Institution would, as they expressed it, be "too conspicuous and too interesting and important to be made an *appendix* to any other existing establishment," and therefore it ought to stand alone on its own proper basis.

Accordingly, the problem of the unemployed still remains with us, whilst the new institution took the form of converting Mr. Mellish's house in Albemarle Street into a place where, by regular courses of philosophical lectures and experiments, the applications of the new discoveries in science to the improvement of the arts and manufactures might be taught, so as to facilitate the means of procuring the comforts and conveniences of life.

The Royal Institution had a troubled infancy. Like the poor it was originally designed to succour, it suffered much in the outset from lack of nourishment. To add to its miseries, the little starveling was caricatured by Gillray, lampooned by Peter Pindar, and ridiculed by Lord Brougham, and it was literally in the throes of dissolution when new life was breathed into it by the opportune arrival, in 1801, of a small spare youth of twenty-two from Bristol, whom the managers had engaged at a salary of 100 guineas a year. The youth was Humphry Davy, who had acted as assistant to Dr. Beddoes, of the Pneumatic Institution, and who had already made some slight stir in scientific circles by his discovery of a characteristic property of nitrous oxide. In announcing his arrival to the managers, Count Rumford reported that he had purchased a cheap second-hand carpet for Mr. Davy's room, together with such other articles as appeared to him necessary to make the room habitable, and among the rest a new sofa-bed, which, in order that it may serve as a model for imitation, had been made complete in all its parts. Six weeks after his arrival Davy was called upon to lecture, and a descriptive paragrapher of the period thus chronicles his success in the *Philosophical Magazine* for 1801:—

"It must give pleasure to our readers to learn that this new and useful institution, the object of which is the application of Science to the common purposes of life, may be now considered as settled on a firm basis. . . .

"We have also to notice a course of lectures, just commenced at the institution, on a new branch of philosophy—we mean the Galvanic Phenomena. On this interesting branch, Mr. Davy (late of Bristol) gave the first lecture on the 25th of April. He began with the history of Galvanism, detailed the successive discoveries, and described the different methods of accumulating galvanic influence. . . . He showed the effect of galvanism on the legs of frogs, and exhibited some interesting experiments on the galvanic effects on the solution of metals in acids. Sir Joseph Banks, Count Rumford, and other distinguished philosophers were present. The audience were highly gratified, and testified their satisfaction by general applause. Mr. Davy, who appears to be very young, acquitted himself admirably well; from the sparkling intelligence of his eye, his animated manner, and the *tout ensemble*, we have no doubt of his attaining a distinguished eminence."

And what was of more immediate consequence, this confident assurance was shared also by the managers, for at a subsequent meeting they unanimously resolved "that Mr. Humphry Davy, director of the chemical laboratory, having given satisfactory proofs of his talents as a lecturer, should be appointed, and in future denominated, lecturer in chemistry at the Royal Institution, instead of continuing to occupy the place of assistant lecturer, which he has hitherto filled."

That such shrewd experienced men of the world as Sir Joseph Banks and Rumford, who were the moving spirits in the management of the institution and genuinely solicitous for its welfare, should thus entrust its fortunes, then at their lowest ebb, to the power and ability of a young and comparatively unknown man, barely out of his teens, seems, even in an age which was familiar with the spectacle of "a proud boy" as a Prime Minister, like the desperate throw of a gambler.

But Banks and Rumford had, doubtless, good reason for the faith that was in them. For a happy combination of circumstances had served to bring the Cornish youth within the range of many who could be of service to him in that search for the fame for which he hungered. His