it is assumed that the curvature of the isobars is identical with the curvature of the path. This is only true in the special case when the pressure distribution remains constant. If the curvature is small or the pressure distribution is changing rapidly, the difference between the curvature of the isobars and that of the path may be considerable, and the gradient velocity obtained by assuming them identical may be considerably in error. Unfortunately, the determination of the wind path is impossible under these special conditions, and the method of determining the gradient velocity then becomes untrustworthy. Mr. Gold optimistically extricates himself from the difficulty by suggesting a method for determining the motion of the centre of curvature from the difference between the observed velocities and the velocities calculated from the curvature of the isobars and the distance between them.

Two theoretical results arrived at by Mr. Gold are of special interest. He has calculated the time required for air, starting from rest, to acquire the gradient velocity and to adjust its motion to the direction of the isobars. The values found for latitude 50° vary between 4 hours and 16 hours for different conditions of motion, and are thus small compared with an interval such as the day. On another page he gives us an interesting counterpart to the well-known fact that strong winds and steep gradients do not occur near the centres of anticyclones. From the opposition of the accelerations due respectively to the earth's rotation and the curvature of the path, he shows that there must be a limiting velocity and a limiting gradient for anticyclonic areas, if it be granted that the motion of the air adjusts itself to the gradient velocity.

The concluding pages of the report are devoted to a graphic summary of the variation of the different elements with height, as disclosed by the ascents carried out on behalf of the Meteorological Office by Mr. Dines at Oxshott in 1906, and by ascents made at Lindenberg, Berlin, and Blue Hill Observatory, U.S.A.

There is one point to which we should like to refer before concluding. Nobody can take up a paper like the present one, which deals so largely with providing the tools for future research, without being forcibly struck by the disadvantages of our English system of units, at any rate for the purposes of dynamical meteorology. Mr. Gold invites us to measure the distance between isobars for intervals of a tenth of an inch in millimetres. The gradient velocity he gives us in metres per second, and provides a subsidiary table for converting these to miles per hour, the units adopted for wind velocity in all English meteorological publications, even in those specially devoted to the investigation of the upper air. He apologises for the incongruity in a special note, and explains it on the score of convenience. Should our would-be investigator require to chart his results, our map-makers will probably offer him outline maps on a scale of miles to the inch, and a further troublesome reduction will be necessary before he can apply Mr. Gold's tables. We note with pleasure that the maps used by the Meteorological Office for its working charts and daily weather reports are on a scale which is closely related to the natural scale $1:10^7$. We wonder whether other offices use similar scales. The advantage of uniformity in such matters is forcibly brought home by a report such as the one we have described.

THE WORK OF THE PHYSIKALISCH-TECHNISCHE REICHSANSTALT IN 1907.

THE work accomplished by the Reichsanstalt last year, as shown by the annual report of that institution recently issued, appears to be of a character useful both to physicists and to the industries which seek its assistance in elucidating various technical problems.

As regards the physical side of the work, the following researches may be mentioned:—

In accordance with a commission received by the institution, tests were started on the exact measurement of very small pressures (of the order of between 10^{-6} and 10^{-3} mm.), the pressures being determined from the deflection of a metallic membrane of 25 cm. diameter by means of the Fizeau interference method. The absolute velocity of sound in dry air (free from carbonic acid) has been investigated and found to be 33192 ± 5 cm. per second. Dr. Scheel has tested some further materials for expansion between $-191°$ and $+16°$ C. with the Fizeau dilatometer described in the previous year's report, and has obtained results varying from 2120 microns per metre for palladium to -41 microns per metre for quartz glass. Scheel and Schmidt have obtained a much lower value for the refractive index of helium than that found previously by Lord Rayleigh and by Ramsay and Travers, the figures of the former being 1·0000340. Some useful work has been done in regard to the specific heat of nitrogen, CO_2 and water-vapour, up to 1400° C., and experiments to determine the saturation-pressure of water-vapour above 100° C. have been commenced.

In the Electrical Standards Department the variations in manganin resistances have been found to be very slight and the "humidity effect" only just perceptible. Resistance coils are now being wound on metallic spools with longitudinal slots to render them somewhat flexible; in this way it is hoped to make any effect due to humidity practically negligible. Measurements of the wave-length of electric oscillations can be made with an accuracy within 1 part in 1000 for long waves (above 1000 metres), and for shorter wave-lengths the accuracy is within 1 per cent. Other experiments have been made with undamped electric oscillations produced after the Poulsen method by means of an arc burning in oxygen. A research of importance to opticians was carried out in regard to the secular variation of the planeness of surfaces of optical glasses, results being given in the report.

In addition to the researches mentioned, a number of routine tests were carried out in the various departments of the Reichsanstalt, some of these yielding interesting results from a commercial standpoint.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

MANCHESTER.—Dr. J. E. Petavel, F.R.S., has been elected professor of engineering and director of the Whitworth laboratories. The following additional appointments have recently been made:—Mr. T. G. B. Osbern, as lecturer in economic botany; Mr. C. H. Lander, lecturer in engineering drawing; and Dr. F. H. J. A. Lamb, senior demonstrator in physiology. Dr. Hans Geiger has been re-appointed to the Harling research fellowship in physics, and Dr. Harry Osborne has been re-appointed a junior research fellow in public health.

THE Department of Agriculture and Technical Instruction for Ireland has issued a circular to committees of management of schools dealing with the question of the liability of school managers and teachers in cases of accidents to pupils in attendance at their schools. In a recent action at law, damages were recovered from a teacher on account of injuries received by one of his pupils in consequence of a dangerous substance, used for scientific experiments, having been left carelessly in the way of his pupils. The department has been advised that teachers may be held accountable for the accidents which may occur as a result of allowing dangerous substances to be within the reach of children so young as to be likely to deal with them in a manner causing injury, or for injuries which may ensue as a result of negligence in allowing these pupils to perform dangerous experiments without providing reasonable safeguards against accident. The object of the circular is to make teachers aware of their responsibility so that all precautions may be taken to guard against accidents to their pupils. Fortunately, it is easily possible to devise suitable school courses of elementary science, including no experiments of a dangerous character, and it may be hoped that this timely warning may interfere in no way with the suitable study of science by boys and girls.

AN address on the teaching of the sciences and the formation of the scientific spirit was given by Prof. Paul Appell, president of the French Association for the Advance-

ment of Science, at the meeting held last week at Clermont Ferrand. From a summary given by the Paris correspondent of the *Times*, we learn that Prof. Appell defines the man of science, not as "the man who knows," but as a man who "combines with his knowledge scientific activity, that is to say, a curiosity always alert, indefatigable patience, and, above all, initiative and again initiative." French instruction, he pointed out, was not generally calculated to develop the latter. The examination system was a trial of memory, not of real knowledge, observation, and experience. The evil extends from the primary schools to the upper special schools, and nothing is more necessary than to begin to oppose this tendency. Prof. Appell's solution would be to utilise universities for scientific education and to substitute for the technical schools, which are now virtually closed to many temperaments that might develop scientific capacities—even a Claude Bernard failed to pass his examination for the medical faculty—open schools in which the selection would take place from among the pupils according to the results of their work for the entire year. He would substitute for the two or three years now passed in the Lycée to prepare for the entrance into the upper special schools a course of scientific training immediately after the close of secondary studies. Prof. Appell developed an elaborate system of re-organisation of the universities involving a complete change in the curriculum of the Sorbonne and in the administration of the Museum of Natural History. He would not, however, in any way alter the character of the Collége de France.

THE Board of Education has issued (Cd. 4184) regulations for the training of teachers for secondary schools. Funds have long been available for the purpose of assisting the training of elementary-school teachers, but there has hitherto been little official recognition of the necessity of making some systematic provision for the professional training of men and women intending to teach in secondary schools. Now, however, a Parliamentary grant of 5000*l.* has been made available from the Exchequer for this purpose, and the regulations under which the fund will be dispensed are of great interest. The Board has decided that the course of training must be taken after graduation or its equivalent, and be confined to purely professional work. It is to be an indispensable condition for recognition as an efficient training college that there shall be access for the students, under proper conditions, to secondary schools which are thoroughly suitable for demonstration and practice, and not less than one-half of the staff must have been successful teachers for a reasonable time in secondary schools. Grants will be paid to colleges, in which the number of recognised students is not less than ten, at the rate of 100*l.* in respect of every complete group of five recognised students, subject to the condition that the grant does not exceed one-half of the total sum paid for salaries on account of services in training the students. It is satisfactory to find so complete an appreciation of the imperative need that the staff responsible for the training of secondary-school teachers must possess high academic qualifications, and be, in addition, experienced and successful teachers. There has been in the past an uneasy feeling that much of the training available for secondary-school teachers was divorced too completely from schoolroom practice and over much concerned with theoretical and historical matters, and these regulations of the Board of Education will serve to inspire greater confidence in the value of the training provided in assisted colleges.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, May 28.—"On the Theory of Capillarity." By Dr. E. T. **Whittaker**, F.R.S.

The fundamental quantities in the theory of capillary phenomena are the *surface-tension* γ (expressed, say, in dynes per centimetre), and the *surface-energy* λ (expressed in ergs per square centimetre). The relation between these two quantities is at once given by the thermodynamic equation connecting available energy with total energy; it is therefore

$$\gamma=\lambda+T\frac{d\gamma}{dT}, \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

where T denotes absolute temperature.

This equation implies that when the area of a surface of separation is increased by 1 cm.^{2} at temperature T, the external agencies do work amounting to γ ergs against the surface-tension: and this energy, together with a further contribution of $-Td\gamma/dT$ ergs which is appropriated from the heat-energy of neighbouring bodies, becomes resident in the film, giving rise to an increase of λ ergs in its internal energy.

The relation between the surface-tension and surface-energy is, of course, exactly the same as the relation between the electromotive force of a voltaic cell and the energy of the chemical reactions which occur in the cell.

The author has deduced the values of λ which correspond to Ramsay and Shield's experimental values for γ, and shows that they satisfy a relation which may be stated as follows:—*The surface-energy λ of a liquid in contact with its own vapour at any temperature is proportional to the product of the internal latent heat and the (absolute) temperature.*

The internal latent heat is intimately connected with Laplace's "intrinsic pressure" K of a liquid, and so with the classical theory of capillary phenomena.

PARIS.

Academy of Sciences, August 3.—M. Bouquet de la Grye in the chair.—A problem relating to the theory of orthogonal systems and the method of the mobile trihedron: Gaston **Darboux.**—Contribution to the dynamical study of motors: A. **Witz.** If, when the motor has arrived at a state of steady motion, the motive power is instantaneously cut off, the moving parts make a certain number of revolutions with a decreasing velocity. From a study of this decreasing velocity important conclusions concerning the effects of friction can be obtained. The application of this method to a gas engine, working a dynamo, gave an efficiency of 79 per cent., as against 78·4 per cent. obtained by using the dynamo as the motor. For smaller gas engines the results were less satisfactory.—The families of Lamé composed of equal surfaces: J. **Haag.**—The tendency of material systems to escape friction: Georges **Rémoundos.**—Detectors for use in wireless telegraphy with points of tellurium and tellurides: Édouard **Branly.** The tripod detectors with points of tellurium or tellurides acting on polished steel belong to the group of radio-conductors working by variations of resistance, and require an external electromotive force for their working. The thermoelectric detectors of M. Tissot belong to a different class.—The conditions and duration of the auto-excitation of dynamos: M. **Swyngedauw.**—The electric arc between a solid electrode and a liquid: G. **Athanasiadis.** Duddell's experiment may succeed when the arc is produced between a liquid anode and a solid kathode. The arc formed between an electrolyte and a solid electrode as the kathode may be produced even with an immersion of 7 cm. or more, the difference of potential being 220 volts, and in certain cases this arc may give rise to the effects of the Wehnelt interrupter, although with reduced intensity. It is impossible to produce an arc between a solid anode and an electrolyte even with a voltage of 220 volts.—The quantitative indications furnished by dissociation spectra: silver: A. **de Gramont.** The number and intensity of the silver lines, obtained in the dissociation spectra of mineral conductors, bear a direct and constant relation with the proportion of the metals in the specimens. Details are given of the lines for various minerals and alloys containing from 1 per cent. to 0·0001 per cent. of silver, and application is made of the method to the study of argentiferous galena.—A new method of preparing pure hydrogen: M. **Maurichéau-Beaupré.** Aluminium foil is treated with a small quantity of mercuric chloride and powdered potassium cyanide. In contact with water this material gives 1300 c.c. of pure hydrogen per gram. Advantages are claimed for this material in aëronautics.—The realisation *in vivo* and *in vitro* of precipitins for ovalbumen: André **Mayer** and Georges **Schæffer.**