humidity and the actual temperature. In some cases the authors prefer to use, instead of the sheets, the heights of the surfaces of equal pressure drawn at intervals of one tenth of an atmosphere. Less accurate results can also be found from observations at the earth's surface, assuming average values for the changes as one ascends vertically. By these two methods it is possible to draw level surfaces and vertical sections that show the pressure and density at different parts of the atmosphere. If the equilibrium were exact the surfaces of equal pressure, of equal density and the level surfaces would coincide. The more these surfaces differ from each other the greater the tendency to motion. Similar considerations are discussed for the oceans, but these do not at present appear to have the same importance as the atmosphere. The second part takes up the representation of velocity. From observations of small balloons the horizontal velocity in different localities and at different heights can be found. These results are averaged with respect to height for the sheets of the atmosphere that were used in the first part of the work. The lines of flow can now be drawn for each sheet and also the curves of equal velocity. In some cases the authors use "isogonal" curves, namely, curves of equal direction of velocity. The use of these curves to solve differential equations is credited to Sandström. It appears, however,[1] to be due to Massau, who called them "isoclines." Towards the end of the volume these diagrams are used to deduce the vertical motion of the atmosphere under the assumption that momentum is a solenoidal vector, a downward velocity indicating precipitation. A supplement of 60 excellent maps comprises conical projections of the earth's surface showing the contour lines, in 24 sheets, and examples of the preceding methods applied to actual cases. The middle of Part II. contains an elegant study of two dimensional vector fields and of the graphical treatment of the operations which occurs in the differential equations of hydrodynamics.

[1] See D'Ocagne, "Calcul Graphique."

It is to be hoped that the authors will complete their work by a third part, on the dynamics of the atmosphere, as distinct from the kinematics, including Professor Bjerknes's own work on this part of the subject, and also extend the period of six hours, which is the limit of their prognostications, at present. A fuller treatment of the thermodynamics of the atmosphere would also be desirable.

F. R. Sharpe

The Theory of Experimental Electricity. By W. C. D. Whetham, F.R.S. Second edition. Cambridge, The University Press; New York, G. P. Putnam's Sons. Pp. xi + 340. $2.50 net.

It gives us great pleasure to welcome a new edition of Mr. Whetham's text-book. This work presents the subject of electricity as a living science and is characterized by a wonderful freshness of treatment. It is thoroughly up to date and includes such matters as the thermodynamic theory of electrolytic cells, conduction through gases, radioactivity and the electron theory. Although of necessity brief, the treatment of these subjects is quite accurate. Excellent judgment has been shown in the choice of material and the newer branches of the science are exhibited in their proper relationship to the old. One of the striking features of the book is the combination of simplicity and accuracy in the proofs used in establishing the important principles of the science.

We regret to observe that two blemishes which we noticed in the first edition have not been removed. The treatment on pp. 35 et seq. of the force due to a charged plane as though the charge resided on both sides of the plane is cumbersome if not actually misleading. The proof on page 105, of the mechanical force on a current due to a magnetic field, is fallacious as it stands; although it is made to give the right result. This matter could easily be rectified without changing the method. We also think that it is high time that Franklin's proof that the charge resides in the dielectric were dropped from the text-

books. The inference from the experiment is fallacious; moreover the experiment does not work if the dielectric is dry and low potentials are employed, or, in any event, if the dielectric is a gas or a vacuum.

Despite these minor blemishes the book is an excellent one. The style is admirable and the whole treatment is calculated to inspire the interest of the student. We can thoroughly recommend its use with classes which have already had a general course in physics.

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SPECIAL ARTICLES

RELATIONSHIP OF THE INDIAN LANGUAGES OF CALIFORNIA

ANTHROPOLOGICALLY California has always been noted for its linguistic diversity, which has been accepted as being greater than that of any other part of the world. Since Powell's standardizing classification, which allotted 22 distinct families of native languages to the state, only one consolidation, that of Shasta and Achomawi, has been positively asserted and generally accepted. Two or three other pairs of languages have for some time seemed to be probably each reducible to a common origin; but the specific similarities determined were weakened by the frequent occurrence of both lexical and grammatical resemblances between many other families which there was no justification for connecting genetically. These grammatical resemblances have been several times discussed by us and attributed to the inter-influence of distinct families, due to geographical contact. The lexical similarities we have assumed, in all but a few cases, to be the result of borrowing. It became clear that until the degree and extent of this mutual influencing and borrowing among unrelated languages were more precisely ascertained, the relationships suspected in the few instances referred to were capable of explanation through such borrowing on a slightly more intensive scale, and would therefore never advance beyond the stage of probability. For this reason we undertook some time ago a comparison of more than 200 stem words in all the languages and dialects of California so far as material was available. From the time the material began to be assembled, some interesting results as to the character and scope of the borrowing of words commenced to appear; but after analysis of the collected information had progressed beyond a certain point, it became apparent that the only satisfactory explanation of the resemblances between certain languages was genetic relationship. On the basis of these indications the grammatical information extant on the same languages was reexamined, and in every instance was found strongly confirmatory. Lexical and structural similarities coinciding and being relatively abundant, true relationships have been accepted as established. The new larger families and their components are:

Penutian, comprising the groups formerly known as Maidu, Wintun, Miwok, Costanoan and Yokuts. This is a relatively large and compact family, occupying practically the whole of the drainage area of the great valley of California.

Hokan, comprising certainly Shasta, Chimariko and Pomo, probably Karok, and possibly Yana. The territory of this family is in the hill country to the north and west of the Penutian, and is more irregular.

Ritwan, comprising Yurok and Wiyot. No new proof on the previously suggested possible relationship of these two languages was obtained, except the negative evidence of complete lack of resemblances of both to any other family, which of course increases the weight of the similarities between the two, insufficient though these may yet be for absolute demonstration.

The number of distinct families in California is thus reduced from 21 certainly to 15 and possibly to 12.

Owing to the absence of one of the undersigned in Asia at the present moment, some time must elapse before our material and conclusions can be finally revised and published. For this reason the present announcement is issued.

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