through the Royal Society Range is to a large degree answered by what I call the "palimpsest theory" (v., p. 175). In effect the outlet glaciers flow down notches cut by earlier headward (or cwm) erosion. I hope to publish shortly a mass of evidence and illustration in support of this sequence in glacial erosion.

GRIFFITH TAYLOR.

Meteorological Bureau, Melbourne, July 26.

Muret Sanders's "Encyclopädisches Wörterbuch" gives "riegel," in addition to the various ordinary meanings of the word "bar," including a bar of soap, eleven other meanings. What advantage is there in the use of a German term over an English term when both have equally varied meanings? The term "riegel" is especially overloaded, as in geography, according to Grimm's "Deutsches Wörterbuch," it is used in South Germany for a "kleine Anhöhe, steiler Absatz eines Berges," and he also quotes its use for a watershed.

Ordinary water erosion would certainly produce a slope with catenary curves if it is operating on suitable rock and under suitable conditions.

The conclusion that the *Discovery* Hut was not erected as designed was not based only on Dr. Taylor's photograph, and there could have been no difficulty in managing the supports on any surface of ice which had not so steep a slope as to be otherwise unsuitable.

The more detailed information regarding the origin of the glacier valleys which Dr. Taylor obviously collected may, as was remarked in the review, explain their origin. Dr. Taylor's further publication will be awaited with interest. THE REVIEWER.

ANNEALING GLASS.

EVERYONE who makes chemical apparatus by blowing glass practises annealing in a rude way by allowing the glass to cool slowly by gradual removal from the flame, or by the use of a smoky flame. In glass works more systematic annealing is effected by slow passage through a long chamber wherein the temperature falls from the incoming to the outgoing end. In the manufacture of optical glass of many different qualities the question of annealing is one of the first importance, as they differ so much in fusibility. Messrs. Hilger have after a careful investigation found the means of arriving at the maximum temperature necessary, and also the necessary rate of cooling, which may progressively become more rapid. Optical glasses may differ as much as 200° C. in the maximum necessary temperature, which temperature may be a long way below any visible softening point. It is desirable not to exceed the necessary temperature, as the very slow cooling at the higher temperature leads to great loss of time.

The method adopted by Messrs. Hilger for testing different specimens of glass is interesting as an example of a physical investigation made with a view to practically useful results. The principle of the method can be described very shortly. Fig. 1 shows a bar of glass supported as a cantilever, and carrying a load. Its edges are ground and polished in the form of two parallel planes. This is set up in an electrically heated muffle, with means for observing the temperature electrically. Polarised light broken up into interference bands by passage through a Babinet's compensator is passed through the glass, and when this is loaded the bands become inclined as shown in the figure, illustrating how perfectly the stress, whether of compression or extension, is proportional to the distance from the neutral axis. If the load is allowed to rest on a support in consequence of the slight yielding of the glass, the rate at which the bands change from the inclined to the straight position can be observed for any known tempera-

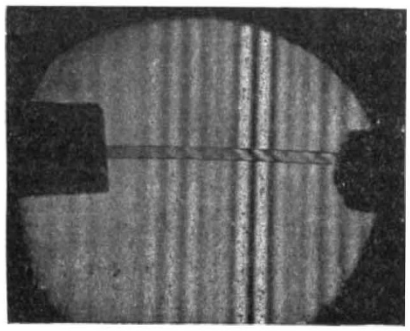

FIG. 1.

ture. Fig. 2 shows two specimens undergoing a change of temperature which sets up strains from the difference in temperature between the interior and the exterior. That the two specimens are very different is only too apparent.

By watching the bands in specimens of glass Messrs. Hilger are able to ascertain when the glass is hot enough to allow the internal strains to be relieved in a convenient time, and whether as the glass cools internal strains are avoided by

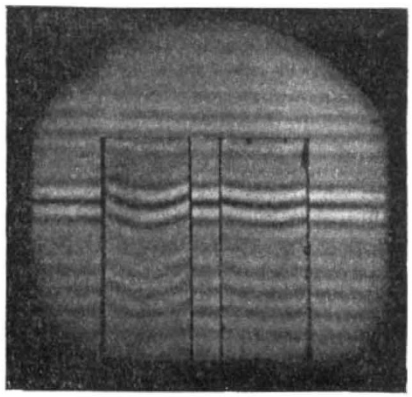

FIG. 2.

sufficiently slow cooling. After a point is reached at which the glass has lost all viscosity the cooling may be accelerated, and though the bands then become curved they straighten out again when ultimately the temperature is equalised. There is no hard-and-fast point at which the glass ceases to be viscous, and so there is a progressive permissible increase in the rate of cooling. Messrs. Hilger have thus shown how annealing may be effected perfectly in the minimum of time. Though

the research was carried out with the object of finding how best to anneal blocks of optical glass, the apparatus is available for testing any glass, chemical or otherwise, and Messrs. Hilger, having the apparatus set up in their laboratory, are prepared to test specimens of glass for the trade, and thus provide the valuable information which they are able so easily to obtain.

C. V. BOYS.

UNIVERSITY AND HIGHER TECHNICAL INSTRUCTION IN FRANCE.

ONE of the principal articles in the *Revue générale des Sciences* for June 30 is that by Prof. Paul Janet, of the Sorbonne, director of the Higher School of Electricity, concerning the *rôle* of the universities in higher technical instruction, especially in relation to the Bill before the French Senate, at the instance of M. le Goy, to sanction the establishment of faculties of applied science in the universities. The proposed measure is exciting considerable interest, not only amongst the learned bodies in France, but also amongst those engaged in scientific industries. The question has assumed a deeper interest in view of the problems raised by the war and of the position and means of development at its close of the national industries, especially those closely dependent upon chemical and electrical science.

Incidentally the question raised by M. le Goy in his project embraces other deep considerations relating to economic problems, including the right direction and utilisation of capital, the question of tariffs and raw materials, a closer union of capital and labour, and especially the creation of a better educated industrial *personnel* in the scientific control and administration of industry, together with measures for the amelioration of industrial conditions. It is urged with considerable force that there is need of a much closer understanding between men devoted to pure science and those engaged in the higher technical industries. The former are often ignorant of the difficulties which beset the engineer and manufacturer, despite the systematic methods he employs in the actual production of commodities; whilst the latter, resenting the accusation that they lack all scientific spirit, do not hesitate to apply derisively the epithet "Sorbonnique" to the science which is incontinently thrust upon them.

Only when this antagonism is entirely removed by a closer sympathy, understanding, and appreciation, on the one hand, of the potentialities of pure science, and on the other of the difficulties which beset its translation into terms of production, can there come that union of effort upon which the successful development of industry depends. In the case of the electrical industry it is freely admitted by all concerned that it finds its solid base in electrical science; nor is it now possible to pretend that any man can hope to become a competent engineer whose technical skill is not founded upon a sound training in science.

The article goes on to consider the existing resources for the training of the expert engineer, and passes in rapid review the faculties of science existing in the universities of France and their competence to train the future technologist; the technical institutes, such as the Chemical Institute at Nancy, founded in 1890, and the Electro-Technical Institute at Grenoble, founded in 1892; the Ecole Polytechnique and the Central School of Arts and Manufactures at Paris, and other special schools in France. An unfavourable view is taken, however, as to the competence of the faculties of science, which have never shown any appreciation of the needs of industry, adequately to train the men, who in fact do not really seek them, destined for industrial pursuits. A firm distinction is drawn between the ideals and aims of the university and the functions of the schools of practical science. The former need for their realisation absolute freedom and long leisure, since their purpose is the exploration and discovery of natural laws, the attainment of exact knowledge as the grand end of their existence, and the moral rather than the material progress of humanity. Research is with them the end, and teaching only the means. The latter, to achieve their purpose, require direct contact with industrial problems, and the due and serious employment of the time of their students, with strict discipline and method and supervised work.

In order to bring the universities into closer touch with industry, it is suggested that they should, with the collaboration of practical men, establish scientific institutes preparatory to industry. It is further proposed to found a very few higher technical schools for more advanced industrial training and research, established and controlled directly by men eminent in industry, yet aided by the State and directly linked with the Ministry of Public Instruction.

PUBLIC SCHOOLS AND OTHERS.

"PUNCH" of September 27, under the title of "Public Schools," prints a poem of which the last two verses are as follows:—

Spite of the anti-classicists' arraigning,
Spite of the ink so petulantly spilt,
Not by exact laboratory training,
Not by the test-tube character is built.

Only in fields of emulous endeavour,
Fired by the teaching of the famous dead,
Public-school boys, who play the game for ever,
Grow into leaders and inspire the led.

PUBLIC SCHOOLS: AN ANSWER.

Dear *Punch*, your poet praises public schools,
Not well, nor wisely, nor by half enough.
Their modern Army Classes, "mostly fools,"
Have shed his "grand old fortifying" stuff.
Their "labs," which he accentuates so oddly,
Seem just as formative, and just as godly.