which the Ordnance map gives no hint. On the "Palæozoic schist" range, south of Suanetia, there are glaciers not very inferior to those of the Grand Paradis group, near Aosta. Dismiss for ever, Mr. Freshfield says, that preposterous fiction about the 120 square kilometres of ice in the Caucasus. It is too soon to say how many square kilometres there really are. One estimate, Von Thielmann's, would make the extent covered by ice close upon 2000 square kilometres, or equal to that in Switzerland—political Switzerland, not the Alps. Mr. Freshfield dwelt on many other points in connection with this interesting range, his notes on the inhabitants of the Caucasus being specially valuable, correcting as they do many prevalent errors.

OUR ELECTRICAL COLUMN.

CONSIDERABLE attention has been drawn to the peculiarities of manganese steel by a paper read before the Institution of Civil Engineers, by Mr. Hadfield. Not only is such steel entirely non-magnetic, but its electric resistance is extremely high. Prof. Fleming (*Electrician*, March 9) gives the following figures:—

German silver	...	20·9	...	·044
Platinoid	...	32·8	...	·021
Manganese steel	...	68	...	·122

The first column gives the resistance in microhms per cubic centimetre at 0° C., and the second column the average percentage variation of resistance per 1° C. between 0° and 100° C. These figures agree very well with those given by Prof. Barrett at the British Association meeting at Manchester.

HEIM has been investigating the electro-positive character of magnesium, with the view of replacing zinc in primary batteries. He finds that in a Daniell cell its E.M.F. is 2 volts, in a Grove cell it gives 2·9 volts, and in a Leclanche cell 2·2 volts. In a bichromate cell it gives as much as 3 volts.

MAGNESIUM can now be produced for about 8*s*. per lb., but local action is considerable, and its constancy uncertain. Hence, except for exceptional circumstances, its practical use is still questionable.

PROF. OLIVER LODGE has been giving some admirable lectures on lightning-protectors at the Society of Arts, and has pronounced the use of copper for such purposes as doomed. He argued that the supposed area of protection was mythical, and that the true way to protect a building was Maxwell's cage. He advocated iron, and showed copper to possess "inertia" to such an extent as to render its use dangerous. He also found that under certain circumstances, such as sudden violent discharges, untempered by time, points were of no use, but he suggested the use of barbed wire along the ridges and eaves of roofs.

THAT careful and accurate worker, Prof. Roberts-Austen submitted a paper to the Royal Society on the 15th inst., in which he narrated his recent inquiries into the mechanical properties of certain alloys that will have an important bearing on the metallic conductors employed in electrical enterprises. He has found that the tenacity of pure gold is very much diminished by the smallest admixture of impurities, and that this follows the order of the atomic volumes of the elements. Those elements the atomic volumes of which are higher than gold greatly diminish its tenacity. Doubtless the same principle is applicable to copper and other metals. The abnormal price of copper has raised a great demand for some better conductor than iron, or some improvement of iron in this respect.

DERHAM'S HYDROMETER.

THE Revenue system of estimating the duty on spirits consists of hydrometer, and tables of strengths for each degree of temperature from 30° to 80° F. When constructing the present Revenue tables of strengths, Sikes ignored the expansion and contraction of spirits due to variations of temperature from the standard temperature of 51° F., and assumed that the strength of any given sample of spirits remained the same at all degrees of temperature. From this false assumption it follows in practice, for example, that 100 gallons 40 overproof at 51° are estimated at 98·9 gallons at 30°, and 101·6 gallons at 80°, of the same strength as at 51°; reducing these quantities to the standard of proof strength, we have—

$$\begin{aligned} \text{At } 30^\circ \ \ldots \ & 98{\cdot}9 \times 1{\cdot}40 = 138{\cdot}5 \text{ gallons of proof,} \\ 51^\circ \ \ldots \ & 100{\cdot}0 \times 1{\cdot}40 = 140{\cdot}0 \quad ,, \quad ,, \\ 80^\circ \ \ldots \ & 101{\cdot}6 \times 1{\cdot}40 = 142{\cdot}2 \quad ,, \quad ,, \end{aligned}$$

showing a discrepancy of over $3\frac{1}{2}$ gallons, although the same actual quantity of spirit is present in each case.

In its original construction, Sikes's hydrometer was not intended to furnish specific gravities, but simply so many indications, respectively corresponding to the strengths in his tables. But it has since been found necessary to supply a table of specific gravities corresponding to the indications of the instrument. It is well known that scientific precision cannot be attained in experiments with the hydrometer, consequently the specific gravities in this table are far from accurate: for example, the specific gravity at the proof point, to the accurate definition of which the Inland Revenue attaches so much importance, is given as ·9233, instead of ·9236. The whole specific gravity table is in fact incorrect, the error sometimes amounting to two subdivisions of the stem. The errors, however, arising from this source are trifling compared with those inherent in the tables of strengths. For the purpose of constructing correct tables of strengths, the best data and those susceptible of the most accurate determination are the specific gravities of the spirits and the percentage by weight of alcohol they contain. The specific gravity of proof spirit, as defined by the Spirit Act is ·9236; therefore the weight of one gallon is 9·236 pounds. Proof spirit contains 49·3 per cent. by weight of alcohol, of specific gravity ·79385 at 60°; therefore one gallon of proof spirit contains—

$$\frac{9{\cdot}236 \times 49{\cdot}3}{100} = 4{\cdot}553 \text{ pounds of alcohol.}$$

To determine the true ratio of any spirit to proof spirit nothing more is required than to ascertain the weight of alcohol in one gallon of the spirit, and to divide that weight by the pounds of alcohol in a gallon of proof spirit; for example, spirit having a specific gravity of ·825 at 60° weighs 8·25 pounds per gallon; its percentage by weight of alcohol is 89·13; therefore one gallon contains—

$$\frac{8{\cdot}25 \times 89{\cdot}13}{100} = 7{\cdot}353 \text{ pounds of alcohol,}$$

equivalent to

$$\frac{7{\cdot}353}{4{\cdot}553} = 1{\cdot}615 \text{ gallons of proof spirit.}$$

Or 100 gallons are equivalent to 161·5 gallons of proof spirit, and the spirit is said to be 61·5 overproof. It is obvious that although the bulk and specific gravity of a spirit vary with the temperature, the percentage by weight of alcohol it contains does not vary from that cause. The specific gravity of the spirit in the preceding example is ·839 at 30°; the weight of one gallon therefore is 8·39 pounds; its percentage by weight of alcohol is 89·13 as before; therefore one gallon contains—

$$\frac{8{\cdot}39 \times 89{\cdot}13}{100} = 7{\cdot}478 \text{ pounds of alcohol,}$$

equivalent to

$$\frac{7{\cdot}478}{4{\cdot}553} = 1{\cdot}642 \text{ gallons of proof spirit.}$$

The strength of the spirit, therefore, at 30° is 64·2 overproof.

It should be here pointed out that the diminished bulk of the spirit at 30°, as compared with its bulk at 60°, is exactly compensated, in estimating the equivalent value in proof gallons, by the increased strength at the former temperature; for 100 gallons of spirit 61·5 overproof at 60° contract to 98·33 gallons at 30°; and, reducing to proof strength—

$$\begin{aligned} 100 \times 1{\cdot}615 &= 161{\cdot}5 \text{ gallons of proof spirit,} \\ 98{\cdot}33 \times 1{\cdot}642 &= 161{\cdot}5 \text{ do. do.} \end{aligned}$$

whence it is evident that, by the employment of correct tables of strengths, the estimate of the equivalent value of a given quantity of spirit in gallons of proof spirit would be identical at all degrees of temperature. The spirit tables published by Dr. Derham, to which Sir Henry Roscoe lately called the attention of the Chancellor of the Exchequer, are calculated on this principle.