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THE UNITED STATES will make a creditable display at the Paris Exhibition. And this is as it should be; for, although nominally a universal exposition, it will be practically a display of the products of republics. The monarchies of Europe will be represented only by private exhibits, while the republics of North and South America have rallied in force. The United States Department of Agriculture will make a splendid showing. Secretary Colman has placed the undertaking in the hands of Professor C. V. Riley, the famous entomologist, an energetic organizer as well as a careful and enterprising scientific observer; and Professor Riley has already sent forward three car-loads of products, which are on the way to France in charge of Mr. F. T. Bickford, an assistant. The bulk of shipments are nearly through with, and the perishable staples will follow during the next month. Congress appropriated $250,000 to aid exhibiters, and Secretary Colman's quota of this will insure the best illustration that the agricultura. resources of this country have ever had on the continent of Europe Various branches will be represented as follows: fruit, Professor VanDeman and Professor George Hussman; grain, George N. Hill, St. Paul, Minn.; cotton and fibres, Col. James A. Benford, Duck Hill, Miss., and Charles R. Dodge, Boston; tobacco and peanuts, Alexander McDonald, Va.; agricultural education and experimental stations, W. O. Atwater, Department of Agriculture; vegetables, including hops, M. G. Kern, St. Louis; entomology, including apiculture and silk-culture, C. V. Riley, N. W. McLean of Hinsdale, Ill., and Philip Walker, Department of Agriculture; sorghum and other sugar-plants, H. W. Wiley, Department of Agriculture; forestry, B. Fernow, Department of Agriculture, and M. G. Kern of St. Louis; grasses and forage-plants, George Vasey, Department of Agriculture; meat products, Dr. de Salmon, Department of Agriculture. All articles for exhibition will be forwarded free from New York, and no charge will be made for space in Paris. Professor Riley has put forth unusual exertions to get the exhibit on the road, and he looks forward with much enthusiasm to the result. He will not leave for Paris till the first week in April.

PHOTOGRAPHIC MAP OF THE NORMAL SOLAR SPECTRUM.

A NEW and greatly improved edition of this map, made by Professor H. A. Rowland, extending from the extreme ultra violet down to and including B to wave-length 6950, is now ready. The old map, published in 1886, was made by means of a grating ruled on the old dividing-engine, which was originally intended for only small gratings, and at a time when Professor Rowland's knowledge of photography was limited. Furthermore, it was not printed in a sufficiently careful manner; and the negatives, which were originally none too good, soon became broken or defaced, so that many of the prints, especially the later ones, were not satisfactory.

The whole work has now been gone over again. A new dividing-engine to rule large gratings has been constructed, and has proved to be superior in every way to the old one, although the old one is almost equal to it for small-size gratings. It has been placed in the vault of the new physical laboratory, where an almost constant temperature is maintained. Several concave gratings of 6 inches diameter and 21½ feet radius have been ruled with 10,000 or 20,000 lines to the inch, giving definition hitherto undreamed of. These have been mounted in the best possible manner. The laboratory contains rooms for developing, making emulsions and dry plates, complete enlarging apparatus, and, indeed, every facility for photographic work on the spectrum of the sun; and a large steam-engine, a variety of dynamos, continuous and alternating current, with Ruhmkorff coils of all kinds, one of which latter will melt down iron wire larger than one-sixteenth of an inch in diameter in the secondary circuit, give means of future investigation on the spectrum of the elements. Professor Rowland has devoted years to the making of dry plates, simple and orthochromatic, and is thus better prepared than before for the work of making the map. He has also revised his list of standard wave-lengths, and extended them into the ultra violet, and has placed the scale upon the photographs with greater care than before. The printing is carried on in Baltimore, where it is under the immediate supervision of Professor Rowland.

The negatives have been made on thick French plate glass, and the prints are much more artistic than the old ones. The definition is not only much finer throughout, but the prints are much more uniform, and have fewer spots.

The process of making this map is the same as that used for the old one, and is based on the property of the concave grating as discovered by Professor Rowland: this property is, that the spectrum, as photographed in any given order, is normal, and of the same scale throughout. The focus remains automatically adjusted, so that one has only to move the instrument to the part of the spectrum required, absorb the overlying spectra, and put in the photographic plate. The negatives enlarged have been selected from many hundreds taken from different gratings, though three gratings were finally selected for the work. The negatives from any given order of spectrum are measured from one standard line to another on a dividing-engine, so that the constant of the dividing-engine is known. The scale is then made by ruling on a piece of French plate glass having a coating of blackened collodio-chloride. The negatives are then clamped to the scale firmly, after being adjusted into position by the standards. They are then put in the enlarging apparatus, and the whole enlarged from two and a half to possibly four times, so as to make the scale of the map about three times, that of Angström's map. The positives thus made are then figured, and negatives made from them by contact.

In the negatives so far examined, the scale has been placed within less than $\frac{1}{20}$ Angström division, or $\frac{1}{100000}$ wave-length of its true position.

As to the definition, much is lost in the enlargement, not so much from want of definition in the enlarging lens, a 25 by 21 inch Dallmeyer, rapid rectilinear, as from the radical defect of photographic processes; for, when one brings out the fine doubles in which the streak of light in the centre is very faint, he loses many of the fainter lines. The original negatives show E, and even finer lines like that at wave-lengths 5276.1 and 5914.3, plainly double, but there is little hope of showing this on the map.

The atmospheric line just outside of one of the D lines also nearly merges into it, although in the original negative it is widely sundered from it.

However, there are few instruments which will show more of the spectrum than can be found on the map, even below the D line, where cyanine and chlorophyl plates had to be used, for the first line in B is shown widely triple. Above, and including the D line, the definition rapidly improves, and a low-power magnifier must be used to bring out the full definition. However, from wave-lengths 5300 to 3800 the superiority over the old edition is not so marked as above and below this. In the ultra violet above H there is an immense improvement in the new, both in definition and in the quality of the photograph.

As to comparison with other maps of the spectrum made by measurement and drawing, it may be said that no comparison is possible. The photograph is the work of the sunlight itself, and the user of this map has the solar spectrum itself before him, and not a distorted drawing full of errors of wave-length and of intensity. The superiority is so great that there is no possibility for comparison.

The following is a list of the plates, each 3 by 2 feet, containing two strips of the spectrum: *a* includes from wave-length (?) to 3350; *b*, from wave-length 3270 to 3730; *c*, from wave-length 3670 to 4130; *d*, from wave-length 4050 to 4550; *e*, from wave-length 4450 to 4950; *f*, from wave-length 4850 to 5350; *g*, from wave-length 5250 to 5750; *h*, from wave-length 5650 to 6150; *i*, from wave-length 6050 to 6550; *j*, from wave-length 6450 to 6950.

Negatives *b, c, d, e, f, g, h, i, j*, are now ready, although that for *i* is too irregular to be entirely satisfactory, and it may be replaced. The plate *a* to the extremity of the solar spectrum will be attempted this summer, but may cause much trouble and delay, and will be sold as an extra plate. The prints are on heavy albumen paper mounted on cloth.

The cost of printing has been so much increased that the prices for this new series will be greater than for the old one, but scarcely more than covers the cost of the printing.

The plates will be delivered in Baltimore or New York, or will be sent by express or mail, securely packed, at the charge and risk of the purchaser, at the following net prices: set of nine plates, wave-length 3270 to 6950, $18; single plates, $2.50. Should any extra plates continuing the spectrum in either direction be published, subscribers can have them at $2 each. Subscribers to the old edition will have the preference in the delivery of the new one, and a reduction of 10 per cent in the price. The three plates *h, i, j*, to complete their set, will be furnished for $6. They are advised to take *g* also, as the old map of that region was bad. The four, *g, h, i, j*, will be furnished to them for $8.

Two plates, each 3 by 2 feet, suitable for framing and hanging on the wall, have been made of the B and D lines. The latter are 3 inches apart, and the former has an extent of about 24 inches. Enlargements of some of the carbon bands from the arc electric light have also been made. They show the wonderful structure of these bands, each containing many hundred lines, each one of which is a close double, or, in some cases, a triple. These plates will be sold for $2.25 unmounted, or $2.50 mounted on cloth. No plate will be given away or sent in exchange. Remittances may be made by draft or money-order. All subscriptions and orders should be sent, and remittances made, to the Publication Agency of the Johns Hopkins University, Baltimore, Md.

THE EARTHQUAKE OF LIGURIA, FEB. 23, 1887.

MESSRS. T. TARAMELLI and G. MERCALLI have made an exhaustive report on the earthquake of Liguria in February, 1887, to the Italian Department of the Interior. A geological and an historical chapter form the introduction, which is followed by an account of the results of the authors' studies and inquiries. They visited all localities that were severely damaged by the shocks, while information on others, which they were not able to visit, was collected by means of circulars of inquiry. Thus exhaustive reports on the character of the earthquake were obtained from over eleven hundred localities. This abundant material, arranged and discussed systematically, forms the basis and the main part of the report. The results of this discussion are summarized by the *Naturwissenschaftliche Rundschau* as follows: —

Many insignificant, preparatory shocks preceded the Ligurian earthquakes of 1752 and 1854, as well as that of Feb. 23, 1887. In the night from Feb. 22 to Feb. 23, four light shocks were felt over exactly the same territory that was visited by the severe shocks of the following day. Evidently the seismic centre was in full activity that night; but there are only four indications, as no seismic instruments and observers exist on the Riviera di Ponente. A little while before the earthquake began, the sea was observed to be exceptionally quiet. A few observers claim to have seen unusual lights in the atmosphere. In the regions which suffered most severely, animals were observed to be restless. In a very few places a change of springs was observed. Thermometer and barometer were not influenced by the shocks.

The principal shock was observed in a circular area covering about 568,000 square kilometres. Its southern limit is Rome and Mount Ferru in Sardinia. Eastward it extends to Pordenone, westward to Perpignan, and northward to Dijon and Basle. The shocks spread with greater force northward to France and western Switzerland, than southward on the Italian peninsula. According to the intensity of the phenomena, the authors distinguish four zones; the central region, in which the most formidable destruction took place, forming a zone a hundred kilometres in width along the coast from Mentone to Albissola. It embraces a narrow coast strip, because the seismic centre was situated in the sea, and because the old crystalline rocks of the Ligurian Apennines reflected the seismic waves. The next zone is called by the investigators the "almost destructive" one. It extends to the hills of Piedmont. Very strong shocks were felt in the third zone, which extends from the second principally north-westward, including Turin and the low-lying Canavese, where the shocks seem to have been increased in violence by waves reflected from the gneissic mass of the Grand Paradiso. The last zone embraces those places in which the earthquake was felt, but did not do any damage.

In the whole territory where the earthquake was strongly felt, the first shock lasted thirty seconds, and consisted of two shocks almost immediately following one another. Each of these shocks caused first a subsultory, then an undulating motion. In no place, not even in those where the shocks were most destructive, was the movement vertical. Therefore the resultant of both shocks was much influenced by local causes, and neighboring places show great differences in the direction of the shocks. The second shock was the stronger one, causing particularly a strong subsultory movement. Only in Nice and other places in France the first shock was the strongest. The second part of the shock was everywhere complicated by the resultant action of its combination with the first shock. This accounts for the fact that the second shock frequently left the impression of a rotatory movement. In many places, for instance in Mentone, objects lying on the ground have been turned round. In places lying at greater distances from the central point, the vertical component decreased rapidly, but all the other peculiarities of the shock remained. In the outlying zone the slowness and regularity of motion of the shock were remarkable, which caused pendulums three feet and more in length to swing.

At various places the horizontal velocity caused by the shock was determined by observations, and by objects thrown some distance. At Oneglia the force was large enough to give a portion of a sill, weighing about five thousand pounds, an initial velocity of thirty-one feet. This horizontal force decreased with increasing distance