tirely unknown portion of the spectrum extends about four times as far from the most refrangible line hitherto photographed (the aluminum line 1,852), as that line is beyond the blue hydrogen line of wave-length 4,861. The interest in these researches is, therefore, very great; and it seems as though the limit of the radiations might only be reached when we can detect them in the universal ether itself, unaffected by a trace of an absorptive medium, and with photographic plates of special character.

The ordinary plates do not serve for work of this kind. The plates used by Mr. Schumann are specially made by himself, and are peculiar in possessing great sensitiveness to the ultra-violet rays, but relatively very little to the light of the visible spectrum. Because of this insensitiveness to the visible spectrum, the plate acts toward the ultra-violet precisely like one exposed to filtered light, from which all the rays have been absorbed, which, as diffused light in the spectrograph, would tend to cause fogginess of the picture. Such is the effect when an attempt is made to photograph the ultra-violet spectrum with an ordinary plate; for, before the ultra-violet rays have affected the plate, or produced a distinct image, the plate is fogged all over by the diffused light. The method of making the new plates is not yet published, because the investigations are not yet completed nor ready for publication.

Photography in a vacuum presents some difficulties and requires far greater care than under ordinary conditions, even under the most favorable conditions the photographic effect of these extremely refrangible radiations is relatively so very weak that on many plates prepared according to the new method it was difficult to establish even the existence of the vibrations of the shortest wave-lengths.

We may look forward with the greatest interest to the early publication of full details and results of this most skilfully conducted investigation, which has so greatly extended the known limits of the invisible spectrum.

ROMYN HITCHCOCK.

1455 Mass. Ave., Washington, D.C., Feb. 20.

METALS AT HIGH TEMPERATURES.

ON Feb. 5, Professor Roberts-Austen, C.B., gave a very interesting lecture on metals at high temperatures at the Royal Institution. As was to be expected, nothing very novel was brought forward, but the lecturer certainly succeeded in demonstrating to a large audience results which have hitherto been only obtained in the laboratory. Every one who has ever heard Professor Roberts-Austen lecture, knows his fondness for experimenting with gold, which no doubt is mainly due to his position at the mint, though, apart from this, many would find a certain fascination in handling and experimenting with such a metal. Moreover, gold is a metal remarkable for other properties besides its monetary value. On previous occasions Professor Roberts-Austen has drawn attention to the fact that its properties are changed in a most remarkable manner by alloying it with small percentages of other metals, and on the present occasion he exhibited a new series of alloys of this metal with aluminium which are of equal interest to those previously known. One of these alloys in particular, containing 20 per cent of aluminium, is noteworthy, as it forms an exception to the usual rule that the melting point of an alloy is lower than that of either of its constituents. This alloy, on the other hand, has a fusing point above that of gold, the most infusible of its constituents. Curiously enough, the alloy with 10 per cent of aluminium follows the ordinary rule. These alloys, it should be added, have the most brilliant colors. The 20 per cent alloy is a brilliant ruby in tint, whilst those containing greater percentages of aluminium are purple in hue.

With the aid of the oxy-hydrogen blowpipe and M. Le Chatelier's pyrometer, the lecturer was able to show a large audience the peculiarities of the cooling curves of several metals, and also to measure the fusing points of some of the most refractory of them. Indeed, he succeeded in fusing iridium, using for the purpose the electric arc, the thermocouple employed as pyrometer consisting of a rod of iridium, and a rod of an alloy of the same metal with 10 per cent of platinum. The temperature thus reached is stated to be the highest yet measured, viz., 2,000° C., and thus it is now possible to measure temperatures ranging from − 200° C. to + 2,000° C., the former temperature having been attained by Professor Dewar in his lecture to the Royal Institution some short time back.

Even before the invention of this instrument, Professor Roberts-Austen stated that very considerable progress had been made in pyrometry, so that Mr. Callender, with his improved Siemens apparatus, in which the change in the resistance of a platinum coil, as it grows hotter, is used as a measure of the temperature to which it is exposed, has succeeded in measuring temperatures of 1,500° C., with an error of not more than one-tenth of a degree.

In measuring lower temperatures than the fusing point of iridium, the thermo-couple used consisted of a couple of wires, one of platinum and the other of an alloy of this metal with 10 per cent of rhodium, simply twisted together. This couple was inserted in the mass of a clay dish, on which gold and palladium, etc., were melted by the aid of an oxy-hydrogen flame. The ends of the wires were coupled with a suitable reflecting galvanometer, which by means of a powerful lantern threw a bright spot of light on a long scale fixed to the wall of the lecture-room. By means of this apparatus Professor Roberts-Austen was able to exhibit the recalescence of iron and show that at this point the metal suddenly becomes magnetic. For this purpose a block of iron heated to redness was placed on a stand fitted with a thermo-couple and an ordinary magnetic needle, which carried a mirror reflecting a second spot of light on the screen. At a high temperature iron is non-magnetic, but as it cooled down the spot of light from the pyrometer travelled down its scale, till at the point of recalescence it became stationary, and at the same moment the second spot of light connected with the magnetic needle suddenly swung over, showing that the metal had then become magnetic. Of more immediate interest, from a practical point of view, was a second experiment exhibited. In this a bar of iron, heated to bright redness, was fixed at one end and loaded at the other. Instead of bending over under the influence of the weight, which of course was not large, it remained rigid until it had cooled down to its point of recalescence, when it suddenly began to deflect.

Professor Roberts-Austen maintains that these peculiarities point to a re-arrangement of the molecules of the metal, and that they occur even with chemically pure iron, being intrinsic in the metal and not merely the effect of foreign constituents, though of course these are of considerable importance in modifying the results observed. That such changes occur in practice there can be little doubt, though the effects seem often to be peculiarly local. Steel plates showing very considerable ductility on test have snapped simply from internal stresses without showing the slightest signs of elongation or contraction of area at the point of fracture, making it difficult to believe that during fracture the molecular arrangement of the particles affected by the fracture has been the same as when specimens of the same plate have shown perhaps 18 per cent elongation and 30 per cent contraction of area in the testing machine. These facts would almost lead to the conclusion that a sort of wave of molecular change may arise in a steel plate, during which abnormal fracture may occur, and after which the material of the plate may be found in its ordinary condition. By working at a blue heat, it is known that such a molecular change is produced, and the fracture of a mild steel bar thus treated shows that the metal has become brittle, but such a change is permanent. It is, moreover, certain that liability to this class of fracture is increased by the presence of certain impurities in the metal, the amount of which is often astonishingly small, and much light will probably be thrown on these points, says *Engineering*, by investigations now in progress.

It is not necessary that these investigations should, in the first place, be conducted on steel itself, as it frequently happens in scientific work that a problem is more easily solved by first dealing with simpler analogous cases than by a direct attack on it in all its complexity. For a flank attack of this character, gold, apart from its value, offers many advantages, as it is easily obtained in the pure state, and is at the same time profoundly affected by alloying it with very small quantities of other metals, which changes it is difficult to explain on any other hypothesis than that of an altered molecular grouping.

JOURNEYS IN THE PAMIRS AND ADJACENT COUNTRIES.[1]

THIS was the subject of the paper read at the meeting of the Royal Geographical Society, on Feb. 8, by Capt. F. E. Younghusband. The author described two journeys, one in 1889 across the Kárákorum and into the Pamir, the other in 1890 to Yarkand and Kashgar, and south to the Pamirs again.

"The country," he said, "which I now wish to describe to you is that mountainous region lying to the north of Kashmir, which, from the height, the vastness, and the grandeur of the mountains, seems to form the culminating point of western Asia. When that great compression in nature took place this seems to have been the point at which the great solid crust of the earth was crunched and crushed together to the greatest extent, and what must have formerly been level peaceful plains such as we see to the present day on either hand, in India and in Turkistan, were pressed and upheaved into these mighty mountains, the highest peaks of which are only a few hundred feet lower than Mount Everest, the loftiest point on this earth. It was amongst the peaks and passes, the glaciers and torrents of this awe-inspiring region, and anon over the plain-like valleys and by the still, quiet lakes of the Pamirs that my fate led me in the journeys which I have now come before you to describe."

Starting from Leh, in Ladak, Captain Younghusband's first objective point was Shahidula. This place is situated on the trade route to Yarkand, and is 240 miles distant from Leh. This he left on Sept. 3, to explore the country up to the Tagh-dum-bash Pamir.

The route now led up the valley of a river, on which were several patches of fine grazing, and till last year this had been well inhabited, but was now deserted on account of Kanjuti raids. The valley is known by the name of Khál Chuskún. Chuskún in Turki means resting-place, and Khál is the name of a holy man from Bokhara, who is said to have rested here many years ago. The mountains bounding the north of this valley are very bold and rugged, with fine upstanding peaks and glaciers; but the range to the south, which Hayward calls the Aktágh Range, was somewhat tame in character, with round mild summits and no glaciers. The Sokhbulák is an easy pass, and from its summit to the east could be seen the snowy range of the western Kuenlun Mountains, while to the west appeared a rocky mass of mountains culminating in three fine snowy peaks, which Hayward mistook as belonging to the main Mustagh Range, but which in fact in no way approach to the height and magnificence of those mountains, and really belong to the Aghil Range, which is separated from the Mustagh Mountains by the valley of the Oprang River.

On Sept. 11, the party crossed the remarkable depression in the range which is known as the Aghil Pass.

"From here is obtained one of the grandest views it is possible to conceive; to the south-west you look up the valley of the Oprang River, which is bounded on either side by ranges of magnificent snowy mountains, rising abruptly from either bank, and far away in the distance could be seen the end of an immense glacier flowing down from the main range of the Mustagh Mountains This scene was even more wild and bold than I had remembered it on my former journey, the mountains rising up tier upon tier in a succession of sharp needle like peaks, bewildering the eye by their number, and then in the background lie the great ice mountains — white, cold, and relentless, defying the hardiest traveller to enter their frozen clutches. I determined, however, to venture amongst them to examine the glaciers from which the Oprang River took its rise, and leaving my escort at the foot of the Aghil Pass, set out on an exploration in that direction. The first march was easy enough, leading over the broad pebbly bed of the Oprang River. Up one of the gorges to the south we caught a magnificent view of the great peak K 2, 28,278 feet high, and we halted for the night at a spot from which a view of both K 2 and of the Gushirbrum peaks, four of which are over 26,000 feet, was visible. On the following day our difficulties really began. The first was the great glacier which we had seen from the Aghil Pass; it protruded right across the valley of the Oprang River, nearly touching the cliffs on the right bank; but fortunately the river had kept a way for itself by continually washing away the end of the glacier, which terminated in a great wall of ice 150 to 200 feet high. This glacier runs down from the Gushirbrum in the distance towering up to a height of over 26,000 feet. The passage round the end of the glacier was not unattended with danger, for the stream was swift and strong, and on my own pony I had to reconnoitre very carefully for points where it was shallow enough to cross, while there was also some fear of fragments from the great ice-wall falling down on the top of us when we were passing along close under it. After getting round this obstacle we entered a gravel plain, some three quarters of a mile broad, and were then encountered by another glacier running across the valley of the Oprang River. This appeared to me to be one of the principal sources of the river, and I determined to ascend it. Another glacier could be seen to the south, and yet a third coming in a south-east direction, and rising apparently not very far from the Kárákorum Pass. We were, therefore, now in an ice-bound region, with glaciers in front of us, glaciers behind us, and

[1] Nature, Feb. 11.