of masses. In the course of a communication which I made to the Physical Society of London, at their last meeting, I appealed to the Fellows present to supply me with the missing phrase. In the discussion which followed the paper, this matter was only incidentally referred to; but, although I think that there was a general agreement as to the want, unfortunately the meeting closed without coming to any conclusion as to the best method of supplying the deficiency.

Will some of your readers help me in this matter?

12 Park Side, Cambridge. E. H. GRIFFITHS.

The Swallowing of One Snake by Another.

THE snake incident, described in NATURE, October 25 last, page 620, as having occurred in the reptile-house in the Zoological Society's menagerie, recalls to my mind two similar cases, recorded in the same periodical, vol. xxx. July 3, 1884 ("A Cannibal Snake," by E. H. Evans), and July 31, 1884 ("The Swallowing of One Snake by Another," by C. R. Osten-Sacken). The first case was observed in Java, the other was witnessed by me in Washington, D.C. In the latter case one of the snakes, although three-quarters of its length had already been engulphed in the other, succeeded in getting out, apparently unhurt, as it remained alive and well in the cage a long time afterwards.

In the *Figaro*, July 26, 1894, I found still another instance of the same kind, which happened in the Jardin d'Acclimatation in Paris. A large snake, while attempting to swallow a rabbit, was interfered with by another one, and passed with the rabbit into the body of its comrade of captivity ("L'un des deux passa à la suite du lapin dans le corps de son camarade de captivité"). C. R. OSTEN-SACKEN.

Heidelberg, Germany, October 28.

ON RECENT RESEARCHES IN THE INFRA-RED SPECTRUM.[1]

I PRESENTED to the Association in 1882, at Southampton, an account of some researches made by means of the bolometer, in the infra-red spectrum, formed by a glass prism; but though these labours have continued with occasional intermission during the past twelve years, it is for reasons, which will be explained later, only within the past three years that any notable advance has been made, and only within the past twelvemonth that such a measure of success has been attained as justifies the present communication.

This is not the time to give any historical account of discovery in the infra-red, but all those interested in the subject know that the first investigator here was Sir William Herschel, whose observations consisted essentially in finding that there was something which the eye could not see in a region which he proposed to call the "thermometric spectrum." His distinguished son, Sir John, made a curious anticipation of later discovery by indicating, though crudely, that this invisible heat was not uniformly distributed, and a similar conclusion was reached in an entirely different manner, through the thermopile, by the too early lost Melloni. So ignorant, in spite of these investigations, of those of the elder Draper and of the elder Becquerel, were we till lately, that when, quite within my own recollection and that of most of you, Lamansky in 1871 published, from his observations with the thermopile, a crude little illustration showing three inequalities in the energy curve, universal attention was excited by it among those interested in the subject.

Among other minds my own then received a stimulus which turned it in this direction, and having, as it seemed to me, exhausted the capacities of the thermopile, I invented an instrument for continuing the research, which was afterwards called the bolometer, and with which, in 1881, at an altitude of 13,000 feet upon Mount Whitney, I found spectral regions hitherto unreached, and whose existence had not been suspected.

I returned with a strong impression of the prospective importance of this discovery, and laboured at the Allegheny Observatory in improving all portions of the new method of research, especially of the bolometer and its adjuncts, with the twofold object of obtaining greater sensitiveness to heat, and greater precision in fixing the exact point in the spectrum where the change of heat originated. With the former object such a degree of sensitiveness was at that time reached, that the bolometer indicated a change of temperature of $\frac{1}{100000}$ of a degree Centigrade, and with the latter, such precision that it was possible to fix the relative position of a line, not merely with a possible error of a considerable fraction of a degree, such as Lamansky's determination is evidently subject to, but with a certainty that the error would be within a minute of arc. The range of the apparatus in wave-lengths was almost unlimited as compared with any other process, and both its sensitiveness and its possible precision seemed to be at that time notable as compared with previous methods, for a great advance was made on anything done before with the thermopile, when the presence of the well-known "D" line of sodium was rendered sensible (though barely sensible), even as a *single* line, by the change of temperature. The sensitiveness was also, as has been said, accompanied with the possibility of unusual precision. The results of this labour were laid before the British Association in the communication already alluded to, and which exhibited ten or twelve inflections of the curve in the portion till then almost unknown, which extends from a wave-length of of 1μ to a wave-length of nearly 3μ, at which point the glass prism then used became wholly opaque to radiation. The positions of these inflections were fixed with a precision quite impossible to the thermopile, but this exactness was only obtained in practice by a process so slow as to be almost prohibitory; and with this apparatus the writer personally made in those earlier years such a number of observations as he hardly likes to recall, so disproportionate did the labour inherent in this method seem to the final result.

The justification of this labour seemed to lie in the fact that it does not appear that photography has ever rendered anything much below a wave-length of 1μ—anything, at least, which has been reproduced for publication in a way which gives confidence that we are in touch with the original. The processes which involve the use of phosphorescent substances have given some indications of lines considerably below 1μ, but it is safe to state that the work which has just been referred to as communicated to this Association in 1882, presents almost the only indications which we have possessed, even up to the present time, about the lower infra-red solar spectrum.

Now the curve which was given, even in the later Allegheny observations made with the rock-salt prism, contained but a dozen inflections below the wave-length of $1{\cdot}5\mu$, and these inflections, with their correct prismatic and wave-length positions, represent, I think, most of our present knowledge in these regions even to-day.

To understand the method by which there were attained, but only at this great cost of labour, results till then unreached, it may be repeated that the bolometer had been rendered more sensitive than the thermopile, but that it was capable of being pointed and its position in the spectrum being measured, only by a tedious process which has been exclusively used till lately (but which that presently to be described advantageously replaces). Whichever process is used, when the bolometer thread touches a cold line in the spectrum (since what is black to the eye is cold to it), a larger current flows through the galvanometer, and the spot of light marking the needle's motion is deflected through a certain number of degrees.

From this point forward, the new process, whose results I am about to have the pleasure of bringing before

[1] A paper read to Section A of the British Association, at the Oxford meeting on August 11, by S. P. Langley.

you, differs widely from the old. In the old, two observers at least are engaged: one, who notes that reading of the micrometer or of the vernier, which fixes in angular measure the exact part of the spectral region whence (though nothing is visible) a thermo-electric disturbance has proceeded; and another, who simultaneously notes through how many divisions of the scale the spot of light from the galvanometer mirror is deflected by the same electric disturbance. The process may be compared to a groping in the dark, and it was only by these means that the considerable inflections of the energy curve much below the region about 1μ were then fixed by the bolometer, by being gone over again and again, with what seemed almost interminable repetition, and which did in fact call for over a thousand galvanometer readings to obtain the position and amount of each single inflection of the energy curve, with the degree of accuracy which was then obtained, and which was shown in the former memoir.

If it took two years to fix the position of twenty lines by this process, it would take two hundred years to fix two thousand, supposing they existed, and it became evident that if the bolometer continued to be the only means available, new and more effective methods of using it must be found.

New Methods.

About ten years ago a plan was first studied, which has ever since been maturing, by means of which this work could be carried on, not only with far greater rapidity, but with greater certainty, and by an automatic process. The idea in its original simplicity is very easily understood.

In the old process, just described, the deflection of a spot of light upon a scale was read by one observer, while another read simultaneously the position in the spectrum of the cold band, or line, which caused the thermo-electric disturbance.

Now, in imagination, let us take away both the observer at the circle and the one at the galvanometer, and, in the latter case, remove the scale also, and put in its stead a photographically sensitive plate. As the needle swings to the right or left, the spot of light will trace upon the plate a black horizontal line whose length will show how far the needle moves, and how great the heat is which originated the impulse. If this be all, when (under an impulse originated by the movement of the spectrum over the bolometer thread) the needle swings a second time, it will go over the same place; but if the plate have a uniform vertical movement, proportional to the horizontal movement of the spectrum, the combination of the two motions of the needle and the plate will write upon the latter a sinuous curve which will be, in theory at least, the same as the curve formerly deducible only with such pains from thousands of such galvanometer readings.

If we suppose that the movements of the invisible spectrum over the bolometer thread are controlled by clockwork so that this spectrum is caused to move uniformly, and that three movements are, by accurate mechanism, rendered absolutely synchronous with those of the moving plate, it is clear that we shall be able to readily deduce from the photographic curve traced on the latter, not merely the amount of the heat, but each particular position in the spectrum, of the thread of the bolometer, which alone can correspond with any given inflection of the curve.

Thus simple is the theory; but no one had better occasion to know how difficult the practice would be, than myself.

The researches by the old method, and the early attempts to improve them, were interrupted by my acceptance in 1887 of a position which implies the administrative charge of different branches of the public scientific service and of duties largely incompatible with original research. What time could be spared from these was, however, partly employed in elaborating the plan of investigation just referred to. An appropriation had been asked of Government for the establishment, on a modest scale, of an astro-physical observatory in Washington, whose first work should be the investigation of the whole infra-red solar spectrum, by some means which would open that great region to knowledge. It had been asked of Government because it seemed that such knowledge, if attained, might teach us facts about the sun and the absorption of its rays by the terrestrial atmosphere, which there was ground to hope would ultimately lead to results of such importance as to justify this national aid.

These observations were resumed in 1890 on the new system, with the aid of the Smithsonian Institution, which provided larger and more efficient apparatus, whose design embodied the results of nearly fifteen years' study of these subjects.

Pending the provision of a suitable observatory building, an inadequate and temporary one was erected in the Smithsonian Park in Washington, to shelter the apparatus, presently to be mentioned, with which it was designed to commence work while making provision for more permanent scientific quarters (which I may add are still lacking).

Apparatus.

The Foucault siderostat, perhaps the most powerful instrument of the kind existing, was originally made by Sir Howard Grubb, of Dublin, from my indications; but its dispositions have since been considerably modified. A beam from its 20-inch mirror is conveyed through the slit of a horizontal collimating telescope having a rock-salt objective of nearly seventeen centimetres aperture, and of ten metres focal length, to the prism or grating. The prism is of rock salt of corresponding dimensions, worked (by Brashear) with the precision of, and presenting all the external appearance of one of flint glass. It is mounted on a massive spectro-bolometer (as the instrument which supports the prism or grating used in producing the spectrum is called). This instrument includes a large azimuth circle, over the centre of which the prism is placed, and it also carries the bolometer, which registers the spectral heat. The focal length of the image-forming lens, or mirror, is in this instrument much greater than in the first one used, and all parts of the apparatus are correspondingly increased in size and stability. The most important and novel feature is, however, the mechanical connection of the large azimuthal circle carrying the prism, with a distant photographic plate, susceptible of vertical motion, and which latter takes the place of the scale formerly in front of the remote galvanometer, both circle and plate being moved by the same clockwork, which is of such steadiness and precision as to make the two movements as far as possible perfectly synchronous.

To fix our ideas, let us suppose that the slow-moving azimuthal circle carrying the prism revolves through one minute of arc in one minute of time; in which case the spectrum will move horizontally across the vertical bolometer thread at a proportional rate. Now, if the same mechanism which causes this circular motion of the prism, and of the spectrum, of one minute of arc in one minute of time, causes the photographic plate to move vertically before the galvanometer mirror at the rate of one centimetre of space in one minute of time; if there be no allowance to make for changes of temperature in the prism or for like corrections, if the mechanician has done his part in such perfection that everything works as it should, it obviously follows that, under such conditions, during every second of this minute a portion of the spectrum represented by the small quantity of one second of arc, will have glided before the bolometer thread, and that during this same second the plate will have been lifted automatically through one-sixtieth of a centimetre of space.

This is one relationship of time and space in actual use here, though others may be established by the use of the change-wheels with which the apparatus is provided. The essential thing is that the plate shall show with great precision, and even on simple inspection, not only the inflections of the energy-curve there written down, but the exact relative position in the distant spectrum which the bolometer thread occupied at the moment it caused the disturbance. In the case assumed, for instance, if we suppose that the record on the plate commences with the part of the spectrum whose angular value is 40°, then, since 1 millimetre corresponds to 6 seconds of arc, and so on, the existence of an inflection on the plate at 30 centimetres, 3 millimetres and seven-tenths of a millimetre, would show that the disturbances originated at the point in the spectrum corresponding to an angular measure of 40° 30′ 22″·2.

If the arm which carries the bolometer is n metres long, and if the thread of the bolometer is $\frac{1}{m}$ metres in diameter, the angular value of the bolometer thread is $\frac{1}{mn}$. At present the linear width of the bolometer thread is not very materially less than formerly, but it is used with a longer arm, and its virtual width is accordingly less. In present actual practice (to use round figures) the optical arm carrying the spectrum across the bolometer, is five metres in length; and if the bolometer thread be one-twentieth of a millimetre in width, its angular value is evidently $\frac{1}{100000}$ of the radius of the circle in which it moves, or a little over two seconds of arc. When the heat is distributed over so large an area, that part of it which falls on a thread of given diameter is, of course, proportionately less, so that the greater precision of measurement demands a more sensitive construction of the bolometer, as well as a more accurate mechanism for pointing it. Improvements have accordingly been introduced in the construction of the bolometer, and a need for greater sensitiveness in the galvanometer has necessarily gone with them. This increased sensitiveness has caused increased liability in the latter to both systematic and accidental perturbations, and the elimination of these has been found the most formidable difficulty of the whole process. It has been effected, largely, by placing the whole apparatus under constant temperature conditions.

I take pleasure also in acknowledging the advantage I have found in using both Prof. Boys's quartz threads and the extremely small mirrors which he, I think, first advocated in connection with the well-known form of galvanometer due to Lord Kelvin. These and other collective improvements made in the bolometer and in the galvanometer, have now made the former sensitive to changes of temperature in its strip which are demonstrably less than 1/1,000,000 of a degree Centigrade.

These are the principal pieces of apparatus, though I should mention that a method has been found by which the very large salt prisms used can be preserved in perfect polish while exposed to all the usual casualties of observation. The actual prism in most frequent use was made from a block of salt exhibited at the World's Fair by the Russian Government, and presented to the Smithsonian Institution by its Commissioners. It is about eighteen centimetres, or over seven English inches, in height.

Before entering upon a description of the results obtained, I desire permission to speak of the aid I have received from the gentlemen whose assistance I have been fortunate in securing: first, to Dr. Hallock, then to Prof. Hutchins, Mr. Hubbard, and Mr. C. T. Child, and lately to Mr. F. L. O. Wadsworth and Mr. R. C. Child; the imprint of the labours of the two latter gentlemen being upon almost all the details of the more recent work.

Results.

Let us recall that the infra-red spectrum from a rock-salt prism, such as that used here, is extremely contracted as compared with one from flint, and still more contracted as compared with the wave-length scale. The portion of the spectrum presented by photography reaches a little below the band whose wave-length is about 1μ, and this was asserted by one of the most eminent living authorities on the subject (Dr. John W. Draper), when the writer commenced this work fifteen years ago, to be the absolute end of the heat spectrum. The writer has, however, since carried his investigations by direct measurement to five or six times this wave-length, and by indirect measurement much farther still, though what is here now exhibited does not go beyond a wave-length of about 4μ. The invisible heat spectrum of a 60° rock-salt prism through this great wave-length, includes only somewhat less than two degrees of arc, and the first of these degrees contains the greater proportion of the energy.

On referring to the illustrations exhibited to the Association in 1882, or even to later publications of results obtained by rock-salt prisms, though with the old method, it will be seen that there are shown in the latter publication about a dozen measured inflections of the energy curve below 1μ·5, and it may be remembered that this curve was obtained only by two years' assiduous labour.

We have now before us three energy curves obtained by the new method, each exhibiting the whole infra-red spectrum under examination, with about a hundred inflections. These curves are nearly, but not exactly, similar.

The three were obtained in the same day, each from an entirely independent observation, so that each has given, in a fraction of a day, many times the results previously obtained by two years of labour, and, as it will be later shown, has given these results with a notable gain of accuracy.

But this is not all. These three curves have been taken with a rapid movement of the clockwork and a brief swing of the galvanometer, so as intentionally to suppress all minor inflections and to introduce only the leading features of the spectrum, as shown in eighty or a hundred of the leading inflections (lines), or groups.

This new bolometric method has, however, as will be shown later, a capacity of resolving these into nearly twenty times that number, the minor inflections having been thus designedly suppressed here at first, to better show the character and position of the principal ones. All these energy spectra, by the new as by the old method, are, of course, subject to the slight changes due to invisible clouds constantly passing before the sun, which, with the change of the sun's altitude, and of the consequent lengthening path of its rays, prevent any one of them from being exactly like the other; while, at the same time, everyone here may satisfy himself by direct inspection of the results before him, that there is scarcely any single one of their inflections which is not reproduced in the other two, in exactly the same place, though probably not exactly in the same degree; and when we take different spectral traces, made at different hours of the day, and even on different days of the month—traces which are absolutely independent of each other—and superpose them, experience shows that we may expect to see such an agreement as that in the three here chosen at random for illustration, or in the more detailed one, where the relative probable error is less than one second of arc. Three such traces only are here given (to prevent confusion), but if we follow these coincidences through not three, but ten or more plates, we may well judge (since there seems no possibility here of systematic error) that a result, which all confirm, is reliable, and that, on the other hand, a single inflection on one plate, which the other nine unite in repudiating, is due to some fortuitous cause.

But there is still a higher certainty to be obtained, by a method independent even of comparison or the exercise of judgment. It is founded on the well-known process of composite-photography, where, in photographing the successive members of an assemblage of persons, having similar general characteristics, as of race, character or education, the individual disappears, and the normal type alone remains. In order to apply this method to such results as ours, however, another step in the process must be introduced, and this is an interesting one, for the energy curve itself, however valuable, is a comparatively unfamiliar method of showing variations in the energy, which we are all alike used to seeing in the visible spectrum given by linear representations, and not by a system of inflections.

In describing this new step, which is to give us a *linear* spectrum in addition to the original curve, it will be desirable to also give evidence of the statement now made, that the present method is capable of recording far minuter inflections than those shown in the curves here exhibited, which, as has just been stated, have been taken only for the purpose of illustrating such more important features, as can be seen and verified by the audience, and especially for showing the agreement of independent observations. The evidence of the capacity of the apparatus to show this detail will best be illustrated by applying our purely thermometric method to some well-known lines in the visible spectrum, such as the familiar "D" lines of sodium. I have already stated that ten years ago the bolometer was barely able to distinguish this as a *single* line. At the present time our little thermometer, as you here see, now shows not only the two "D's" as separate lines, but the nickel line between them. First we have the complex energy curve (Fig. 1), where we see successively the inflections due to the motions of the galvanometer caused by the cold in D_1, then to the smaller chill from the nickel line (aided perhaps by that from some of the close atmospheric lines), then the chill from D_2.

Immediately below this curve is the more familiar linear representation of the same subject (Fig. 2). Now this linear representation, it is most important to observe, has been obtained, not by drawing, but by the subsequent application to the curve of an automatic process, by means of which its indications are reproduced by photogravure, as separate lines, while by the same automatic process the most complex spectral curves can be rendered into their linear equivalents.

I have no space to enter here on a description of this process, further than to say it is effected by means of a systematically distorted image of the curve, obtained by a special combination of spherical and cylindric lenses. You will see, on minute inspection, that the inflections of the galvanometer curve have been slightly "loaded," to produce a more effective contrast of light and dark. Except for this, which can in no way affect the position of a line, but only its intensity, the whole process is as absolutely automatic as any photograph of the visible spectrum.

This thermograph of the "D" lines has been chosen to indicate the grasp of this new thermometric method, by applying it to the test of an object in the visible spectrum, with which every physicist here is doubtless familiar. He may then be invited to recall that the distance between the "D's" in a rock-salt 60-degree prism is about eleven seconds of arc, and to observe that two lines about half this distance apart are here shown as sharply divided by this thermal method, as, for instance, are the components of the double star *a* Geminorum by a three-inch achromatic. Obviously, then, our method could indicate the existence of two lines, little, if any, more than one-quarter the distance between the "D's." Lines 3″ or less apart can then evidently be indicated by this method, even in its present stage of development.

And now, returning to what has been said about the evidence obtainable as to the perfect coincidence of these inflections in different energy curves obtained at different times, and to the consequent evidence that each inflection so given is real, and not the product of an accidental variation in the curve, we may conceive that from any number of such independent curves, any number of such linear representations of the spectra have been obtained; for example, that ten such linear representations of the whole spectrum as are here given of the D lines only, have been so found from ten complete energy curves taken on as many different days. From these ten linear representations, by the well-known processes of composite photography, *one* final photograph of the spectrum is formed, and on this it is evident we may expect to find only what is permanent and not what is accidental, granting that a rare accident may have introduced an occasional abnormal deflection.

Now, considering that the part of the infra-red solar spectrum of rock-salt under review extends through

FIG. 1.

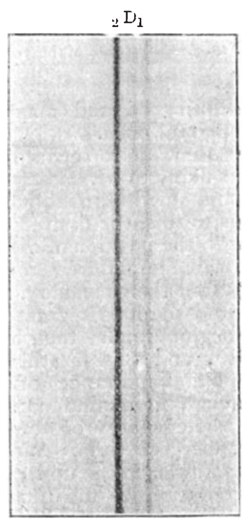
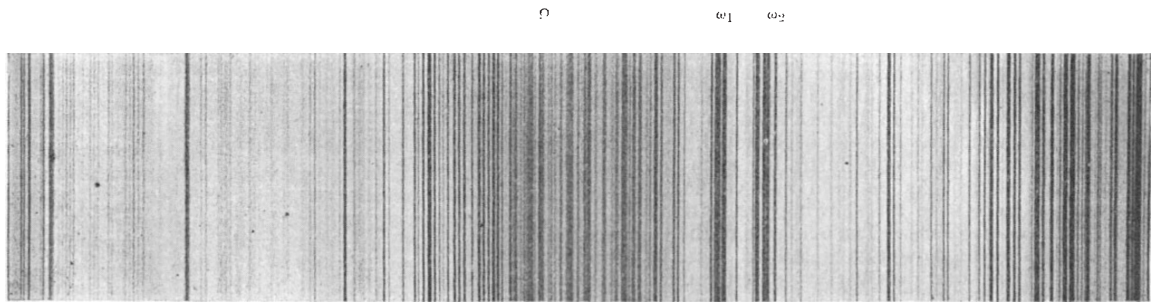


FIG 2

nearly two degrees, or 7200 seconds, and that we have just seen by the illustration of the D lines that lines 3 inches apart can be thus divided, we may see for ourselves that, at any rate, over 2000 lines, if they exist, can be mapped. But these lines do exist, the whole of this new region being apparently as intimately filled by them as the visible spectrum by the Fraunhofer lines. In further evidence of this, here is a portion of the lower spectrum in the comparatively unknown part extending from $\lambda = 1{\cdot}4\mu$ to $\lambda = 2{\cdot}2\mu$ including the great band Ω shown as a single inflection in my first communication to this Association, but here resolved into thirty or more subordinate lines (Fig. 3). This illustration includes a part of the new region discovered on Mount Whitney in 1881; and in the small portion here exhibited, you may see that about 200 lines are discriminated.

I am now trying to bring what may be called the first stage of the long labour, a portion of which is here described, to a close, this first stage consisting chiefly in the discovery of, and mapping the relative positions of new spectral lines.



$1{\cdot}4\mu$ 2.2μ

Fig. 3.—Bolograph of the portion of the infra-red solar spectrum lying between wave-lengths $1{\cdot}4\mu$ and $2{\cdot}2\mu$.

I will only refer to what it seems to me the second part of this work is likely to be, and to the different kind of interest which may not improbably belong to it, from that which belongs to this, the first.

We are thus far in the position of early students of the visible spectrum, who simply drew the lines they saw, without inquiring into their meaning. Nevertheless, to have discovered and mapped a great number of these lines is only a beginning, for their real value lies in their interpretation, and this is still chiefly to come, As to the possible importance of this interpretation, it is not enough to remind ourselves that three-quarters of the whole energy of the sun exists here, and not in the upper spectrum. We must remember also that while, as a rule, in the upper and visible spectrum a great proportion of the lines are caused by absorption in the solar atmosphere, and a perhaps smaller portion by telluric absorption, here, on the contrary, we are led, by everything we already know, to expect that the great telluric absorptions on which meteorological predictions and other immediately practical interests depend, may be expected to be found, and it is on the comparison of these energy curves taken at different periods of the year, and at different altitudes of the sun, that those who are engaged in the work see good cause to hope for important results in the future.

Before I conclude, let me present a collective view of the field in which work has been going on in these later years at the Smithsonian Observatory, on the same scale, with the visible spectrum. I say "on the same scale," meaning, not on a wave-length scale, which expands the invisible at the expense of the visible, and not on a prismatic scale alone, which expands the visible at the expense of the invisible, nor even on such a logarithmic one as that proposed by Lord Rayleigh, but on a conventional scale, which I will ask you to tolerate, as it is simply meant to show the actual extent and importance of the region covered here as compared with that known to Newton. In this illustration, with which I close my remarks, the mean dispersion throughout the invisible rock-salt spectrum, as far as 4μ, is taken as the standard, and both spectra are laid out on that common scale. On the left is the visible spectrum known to Newton; next this, is the region known through photography, now extending a little beyond the band, $\rho\, \sigma\, \tau$, which marks what at the time these researches were commenced, was considered by the then most distinguished investigator, in the infra-red, the end of the heat spectrum. Beyond, and on the right, is a part of the new regions of the spectrum developed by the bolometer, and of which charts may be shortly expected on the scale of which a specimen in detail has just been shown.

I cannot close this statement without expressing the gratification with which I have laid it before the same body that listened to that made on the same subject twelve years ago, or my sense of my good fortune, in doing so before an audience in which I recognise many of the same eminent men who so kindly received that first presentation of these researches.

THE TREATMENT OF DIPHTHERIA BY ANTI-TOXIC SERUM.

FOUR years ago Prof. Behring published his remarkable paper "On the mechanism of immunity agains experimental diphtheria in animals." In this memoir the author stated that it was possible to immunise animal: against the diphtheria bacillus by the injection of culture attenuated by heat or the addition of 1 in 500 tri chloride of iodine to the cultivating medium. The sam result could be obtained by the inoculation of the pleura exudation of animals dead of experimental diphtheri or by the injection of chemical compounds, such a trichloride of iodine, after inoculation of virulent diph theria-bacilli.

Behring's most important discovery, however, wa that the serum of animals immune against the bacillu of diphtheria and its poisons had the power of "destroy ing" in vitro and in the animal body the chemical poiso secreted by this bacillus; and that animals, after a mort dose of diphtheria poison had been injected, could be n only immunised, but actually cured, by the introductio into their system of the serum of animals immunise against the specific bacillus and its poisons. In a furth series of researches he found that the serum of suc animals possessed this power to a most remarkable ar