flows south, and swings northward to their union, the Selkirks and associated mountain ranges being thus completely encircled. Among our party were those who have struggled bravely with such problems, and to their investigations we shall look for further enlightenment.

From Revelstoke the C.P.R. Company has a line of communication by rail and steamboat into the celebrated West Kootenay mining district, by way of that beautiful expansion of the Columbia River known as the Arrow Lakes. Through the liberality of the British Columbian Government, side-excursions were organised into this region, and on our return from Vancouver the majority of our party took advantage of the opportunity to visit the brand-new mining town of Rossland, around which are grouped the chief mines of the district. Here, as everywhere else in the province, every facility was afforded us to see all that was best worth seeing. We visited such well-known mines as the Le Roi, War Eagle, Centre Star, &c., where large deposits of auriferous chalcopyrite and pyrrhotite occur, chiefly in veins near the margin of a mass of gabbro intrusive into Palæozoic rocks. The large smelter at Trail, on the Columbia Railway, a few miles distant, was also visited; and those of us who could spare the time went afterwards into the Slocan country, where the richest mines of silver-lead occur. Space forbids a detailed account of these and other branch excursions in the Province; but if it was intended that we should come away impressed with the mineral wealth of the region, that end was assuredly attained.

It was but a twenty hours' journey from Revelstoke to the coast at Vancouver. After rising out of the Columbia depression the railway finds an easy passage through the Gold Range by the Eagle Pass, apparently a valley of erosion now abandoned; though the suggestion had been made that it was providentially supplied to compensate the engineers for their difficulties in the Selkirks and the Rockies.

A chain of small lakes fills the summit of this Pass, to the westward of which lie many fine moraines. In Eagle River, on its western slope, we were fortunate in witnessing a good example of a salmon run, shoals of great fish crowding the shallows of the stream in every part, and lying dead on every bar.

Shuswap and Kamloops Lakes, and the dry interior plateau of British Columbia with its Tertiary volcanic rocks, were passed in the night, and at daybreak of September 5 we were running down the picturesque cañon of the Thompson River, near its junction with the Fraser. In the Fraser Valley itself there is in this neighbourhood a sharp infold of Cretaceous strata; but lower down we saw only ancient-looking slates, supposed to be Cambrian, along with masses of igneous rocks, both of acid and basic types. Near North Bend, where we breakfasted, a dredger was at work raising the auriferous gravel from the river bed. Below this the valley narrows, and the Fraser races southward for miles through a magnificent cañon, down which the railway also passes. Then, at Yale, the river bursts out of the mountains and swings round westward into a broader and apparently much older valley, which it follows from Hope to the Pacific. Following the river, our track went now amid the dense forest of gigantic trees with which the valley is filled, cleared spaces being as yet quite scanty. Of the Laramie or newer rocks which underlie the Fraser delta, we saw nothing, as on the low ground there is everywhere drift and alluvium. Reaching Pacific tide-water at the head of Burrard's Inlet about noon, we drew up at Vancouver half an hour later.

Our long delightful railway journey was completed, and with it our transverse section of the continent. Starting within the Appalachian rim, we had seen, to the east of the prairies, the old Archæan floor on which the Palæozoic strata rested almost undisturbed; then the prairies themselves, with their vast expanses of horizontal, unfaulted Mesozoic rocks; then the foothills, with the same rocks thrown into wavelike swells; then the outer mountains, with dislocated and overthrust masses of various ages, driven eastward from the centre of disturbance; then the inner ranges, with crumpled and altered strata whose age was no longer determinable, and with the central core of metamorphic and plutonic rocks; and then again, to the westward, infolded and crumpled sediments with many igneous interruptions.

All this had, of course, been described for us already by the Canadian geologists in their admirable official and other publications. But what literature could hope to convey an adequate impression of such a region to one unacquainted with it?

At Vancouver most of us took boat at once across the Straits of Georgia, a few on whom time pressed crossing to Nanaimo, and the majority going first to Victoria, whence a special excursion was afterwards made to Nanaimo. It was a glorious afternoon for the passage—the mountains around Howe's Sound half hidden under storm-clouds and half revealed, and a foreground of high gloomy shores, with the deep recesses of the fjords within gleaming with mysterious light.

On Vancouver Island the heartiest hospitality again awaited us, but of our doings there is small space left to tell. In Victoria we found many of our friends of the two earlier parties, and we of the "Chaudière" held a banquet to do honour to our leaders Dr. Dawson and Prof. Coleman. On Monday we were taken in carriages to the points of chief interest in the vicinity of the city; on Tuesday there was a special train to take us to Nanaimo, where coal of excellent quality is extensively mined from rocks of Cretaceous age; and on Wednesday a number of those who intended to visit the Kootenay started for the mainland. Safe to say that we all left the city of Victoria with reluctance, as most do who visit it.

And now the unity of our party was lost, and its fortunes need be no further followed. For all of us this had been a memorable journey, and we started homeward with a lively sense of gratitude to the Local Committee at Toronto, to the Provincial Governments of Ontario and British Columbia, to the Canadian Pacific Railway Company, and, above all, to our leaders Dr. G. M. Dawson and Prof. A. P. Coleman, by whose exertions the complete success of the excursion was secured.

PROFESSOR VIRCHOW'S JUBILEE.

FIFTY years ago Prof. Virchow delivered his first lecture as a university teacher, and preparations for celebrating the event of the jubilee at Berlin last week had been made, but unfortunately had to be abandoned in consequence of a sudden attack of illness which befell Prof. Virchow whilst lecturing two days before the anniversary. Naturally some alarm was felt, but the attack was not serious and passed off quickly. However, at Virchow's request, the festive arrangements were countermanded, and the day was only marked officially by a congratulatory deputation from the University. According to the Berlin correspondent of the *British Medical Journal* the deputation consisted of the deans of the four Faculties, and nearly all the medical professors. Prof. Schmoller, the University Rector, spoke first, and in a warm and able address praised Virchow as the benefactor of millions, and as the great instructor whose methods had gradually permeated almost all schools of thought. Then followed Prof. Heubner, the Dean of the Medical Faculty. He spoke of Virchow's strong personality, and described the commanding impression caused by his teachings which had revolutionised medical thought. It was true that what might be called Virchow's greatest lifework was the introduction of "methodology" into medicine, but this alone did not explain his immense influence. He had pre-eminently the genius of research, and had traded with his talent as a faithful steward. At an age when others had not finished their studies he had attacked scientific problems with his bold and strong intellect, had gone on from problem to problem, until after ten years his work was crowned by the completion and publication of his "Cellular Pathology." Since then he had become the *præceptor mundi* in medicine. Prof. Virchow, in reply, modestly disclaimed what he called excessive honours. He said he felt like a plant from which the withered leaves had been removed to give it a better appearance. He could not deny that his work had always been full of zeal, and supported by the endeavours to keep in view universal principles; and it was true, also, that a certain soberness of judgment had helped him over great difficulties. If he had succeeded earlier than others in forming a school, he owed this to his recognition of the fact that it was impossible to do everything oneself, and to his success in creating a sort of phalanx for his ideas, which had been of sufficient force to overcome resistance, and to prepare a broad basis for later developments. And thus, he was happy to say, he now felt himself no longer indispensable as representing his school, since there were a sufficient number of men sharing his views. He hoped that his little attack of the day before would have no further consequences, and that he had yet some time for work before him; still he could not hide from himself that it was now time to make a stop, to a certain extent; and therefore he was

doubly glad that he had lately succeeded in convincing the Government that somewhere in Germany there must be a place where every student could at all times find instruction on questions of pathology and medicine, that he had been instrumental in securing the rebuilding of the pathological museum.

THE TEMPERATURES OF REPTILES, MONOTREMES AND MARSUPIALS.[1]

THERE has for many years past been a tendency to diminish or ignore the distinction between the cold-blooded and the warm-blooded types of animal life. Yet the difference is one that is not only real, but in some respects radical. In very few, however, of nature's classes is there found a line of sharp demarcation, and the chief purpose of this paper is to point out that, though the distinction between the two types is real, there lies between these two types a line of steady gradation.

Although the invertebrates have the capacity of producing heat, they are themselves cold-blooded. With the exception of the insects, they very rarely rise more than a fraction of a degree above the temperature of the media in which they happen to be. According to observations of Prof. Valentin, polypi, medusæ, echinoderms, molluscs, crustaceans and cephalopods are able to raise themselves about a fifth of a degree, sometimes as much as three-fifths of a degree, above their environment.[2]

Among insects the power of heat-production is very much greater. Though essentially cold-blooded creatures, in the sense that they have no fixed standard of body-heat towards which they approximate, they are almost always warmer than their media; but if they are at rest that excess is only a degree or two. In case, however, of severe exertion, they are capable of warming themselves to a remarkable extent.

In the case of fish, amphibia and reptiles the same is true. At rest all of them remain at the temperature of their environment, rising and falling with it, and showing no capacity, however rudimentary, of maintaining a fixed and characteristic temperature; yet all can warm themselves by exertion. The large blue-tongued lizard, which is common in the southern parts of Victoria (*Cyclodus gigas*), can warm himself as much as half a degree in ten minutes of anger. In five experiments of this sort I found that different individuals had different capacities of being irritated, but the average was a trifle under half a degree for ten minutes of exasperation.

By activity, and consequent heat-production, all fish, amphibia and reptiles seem able to keep themselves a little warmer than the air or water in which they dwell. Dutroche tells us (*Ann. des Sciences Nat.*, xiii. p. 20) that the newt can keep itself from 2° to $5\frac{1}{2}$° above the temperature of its medium, the turtle $1\frac{1}{2}$° to $3\frac{1}{2}$°, and the common green lizard of France (*Lacerta viridis*) from 4° to 7°. Max Fürbinger asserts that species of blind-worm rise as much as 8° above the temperature of the air. Fish at rest appear to take almost absolutely the temperature of the water wherein they live, but after a struggle, or any other form of energy, they may warm themselves two or three degrees.

This, however, has no real affinity with a warm-blooded habit. And yet these creatures approach in a remote way the warm-blooded condition by sometimes developing a capacity for heat-production in the action of their viscera. Dumeril has shown that snakes by mere digestion can warm themselves from 2° to 4°, the maximum temperature occurring about twenty-four hours after a meal.

Thus it constantly happens that these animals, though essentially cold-blooded, may be observed at temperatures somewhat above that of their environment. But in general that excess is not great, and it leaves the distinction between the warm-blooded and the cold-blooded type quite unaffected.

The true criterion of the difference is of course the concomitance of the temperature of the animal and its medium. An animal of the warm-blooded type may vary a trifle in its general body temperature when the climate alters, but it maintains an almost constant degree of heat. The reptile, though it may maintain itself a few degrees above the surrounding temperature, always varies with it, rising and falling so as to keep always the same number of degrees in excess.

To see how far this concomitancy held, I placed two specimens of the large lizard already mentioned into a small tank of water, so that only their noses were above water. I then warmed up the water at various rates of speed by means of one or more lamps. The accompanying diagram (Fig. 1) shows how closely the lizards followed the temperature of the enclosing water.

Cyclodus gigas is a very sluggish creature, and if left alone never warms himself by any exertion, yet if one takes his temperature in the early part of the day it will almost always be found to be below that of the air. After sunset it is generally higher. During two years I kept specimens of this species in a box, sometimes six or eight, sometimes only two or three. I took their temperatures morning and evening, not altogether continuously, but throughout the larger portion of that time. The average of all these observations gave for lizards 18°·1, for the air 18°·4. This is a very close approximation considering that the temperatures had the wide range that lies between 12° and 32°. The lizards appear to be a little colder than the air. This I believe to be due only to the fact that, taking temperatures before eight o'clock in the morning, the lizards were still considerably in the rear of the temperature, while between five and six o'clock in the evening, though they were above the air temperature, the excess then did not wholly balance the morning deficiency.

I am convinced that if one took the temperature of a quiet lizard every hour for a month, the average would correspond

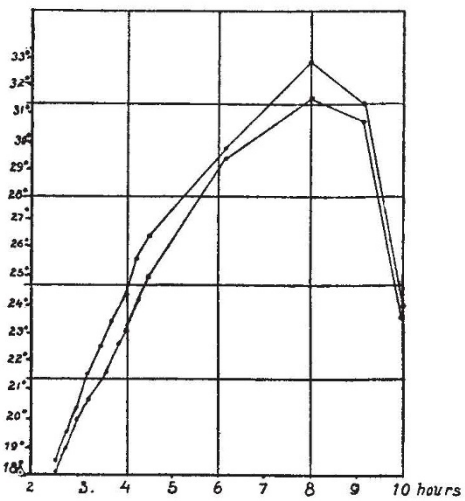

FIG. 1.—To show concomitance of temperatures of lizards and water. Upper line, temperature of water; lower line, temperature of lizards.

almost exactly with the average temperature of the air. The morning and evening observations which I took would give a less exact result, though from them the difference is only three-tenths of a degree.

The steps whereby the more active and intelligent warm-blooded types have arisen from the lethargic level would form a fascinating subject for inquiry, but I purpose here only the much easier and more prosaic one of recording that such steps, however caused, do actually present themselves, and that these are in the most perfect accordance with the existing classification, which is based on anatomical considerations alone.

The monotremes are, in consideration solely of their more reptilian anatomy, placed lowest in the scale of mammals. Their low temperature would entirely justify, were justification in any way needed, the position thus assigned them next to the reptiles. The temperature of the duck-billed platypus has been determined by Baron Miklouho-Maclay to be, as the average of three observations, 24°·8 when the water in which the animals were kept averaged 22°·2 (*Journal* of Linnean Society of N.S.W., viii. p. 425, and ix. 1204.)

Now, the average of forty-five specimens of the ten higher orders of the mammalia, excluding the monotremes and marsupials, is 38°·9, as calculated from Dr. John Davy's lists (*Edin. Phil. Journal*, 1825, p. 300), while the average of a similar but shorter list supplied by Max Fürbinger is 39°. We

[1] By Alexander Sutherland. Abridged from the *Proceedings* of the Royal Society of Victoria, vol. ix. (New Series), 1897.
[2] All degrees in this paper are Centigrade.