H. pictilis, Tate; *H. Stanleyensis*, Petterd; *Bulimus Dufresni*, Leach; and *B. Tasmanicus*, Pfr. The last mentioned species was found in abundance upon the leaves of *Xerotes longifolia*, where, no doubt, among the roots the living specimens of *Pupa Lincolnensis* may be found. The name P. Tasmanica, first given to the shell, has been withdrawn, as on comparison with Angas' *P. Lincolnensis*, kindly given me by Mr. Petterd, I found that the Tasmanian form was not specifically distinct from it.

Hitherto conchologists were of opinion that the genus *Pupa* had no representatives in Tasmania. The discovery of the first representative will, therefore, be of more than usual interest to local naturalists.

Hobart,
December 12, 1881.

ON THE STATE OF THE SURVEYS IN TASMANIA.

By G. McIntyre, Authorised and Licensed Surveyor,
Christchurch, New Zealand.

[*Read 9th May*, 1882.]

At recent meetings of the Royal Society the question of the present state of the surveys in Tasmania and the best methods to be adopted for placing them upon a sound basis was under discussion, and various suggestions were made on the subject. Subsequently, on the 27th October, a letter was published in *The Mercury* under the heading "Field Surveyors," which was intended as a reply to the unfavourable comments which had been made upon the existing survey system. This letter was signed by Mr. J. E. Calder, a gentleman who for several years held the office of Surveyor-General for Tasmania, and is therefore entitled to consideration as dealing with a subject with which it is only reasonable to assume he is well acquainted. Statements, however, are made and reasonings adopted which are open to criticism; while the general impression conveyed to the mind of the unprofessional reader amounts to this:—That the surveys of Tasmania are as good as it is possible to make them in a timbered and rugged country, and that a trigonometrical survey is practically useless.

A system of survey for a large extent of country cannot be considered as in any degree accurate or reliable, unless it is based upon a reference to the True Meridian, which is constant and not subject to the fluctuations and uncertainties attaching,

even under the most favourable circumstances, to the Magnetic Meridian. It is obvious that an unalterable meridian to which all bearings are referred, is, in itself, and apart from any triangulation, of very great value; and when, in addition, the sectional surveys are connected with the stations of a trigonometrical survey, whose relative positions have been accurately determined, a means is afforded by which the boundaries of such sections can be re-established in case of dispute or of obliteration. Such a system is in force in New Zealand and in some of the other colonies—Victoria and West Australia, for example. An accurate triangulation is recognised as an essential and indispensable basis. With this triangulation, sectional surveys are connected, and the position of each peg is tabulated relatively to some trigonometrical station. The limit of error allowed for minor triangulation is two links in the mile, and for sectional work eight links in the mile, the great majority of the surveys executed under this system being actually much within the limit. The true meridian for each meridianal circuit, and which governs the triangulations, is observed as the astronomical station of the circuit. Under a correct minor triangulation, the accumulation of errors inseparable from a system of mere traverse surveys built up the one upon the other, and which in a large extent of country must be very considerable, even where the traverse surveys are carefully executed, is avoided, and the error is not carried forward, but is confined to the country between the trigonometrical stations. The actual error in any circuit traverse, or in a traverse from one trigonometrical station to another, is easily computable by the solution of a series of right-angled triangles, each traverse line being the hypotenuse, and the bearing supplying the angle.

The system in force in Tasmania, looked at from any point of view, must be regarded as extremely faulty, inasmuch as :—

(1.) It is not based upon triangulation.

(2.) The sectional surveys are built up one upon the other, across large areas of country.

(3.) The surveys are not subject to any mathematical check, such as is afforded by a reduction of the traverses to their co-ordinates on the meridian and perpendicular.

(4.) There is no systematic field inspection.

(5.) The limit of error allowed is so great as to preclude anything like accuracy; the confusion and discrepancies arising from this source alone rendering it impossible to re-establish boundaries, even where an admitted starting point is available, within more than a rough approximation.

(6.) In the cities and towns there are no standard survey lines laid down from which to define the true frontage lines of

blocks, and with which to connect the various town surveys required from time to time under the Real Property Act.

(7.) The surveys are made to independent magnetic meridians, the bearings of the initial line in each survey being derived from the compass or needle-reading.

(8.) The office plans and compilations are constructed entirely upon the "building-up" system, without the check afforded by the connection of surveys with accurately determined trigonometrical stations.

With regard to sub-section (7) above, it is perhaps right to note that an independent or isolated survey, executed under the method therein indicated, may be extremely accurate in itself, that is within its own boundaries; but it is obvious that the surveys, effected by a number of surveyors, working to their own independent compass meridians, which, even apart from special local attraction, are certain to vary considerably—cannot be properly compared as to boundaries and relative positions, and are therefore "floating" to an extent which is unknown and practically unlimited.

With respect to sub-section (5), it is not unreasonable to assume that where a certain limit of error is recognised, a considerable proportion of the surveys, especially in rough country, will come nearly up to that limit. The limit of error formerly allowed in Tasmania, and probably still recognised, was 32 links in the mile (1 in 250), a limit three times greater than a fair allowance. A limit of error of 8 links in the mile (1 in 1,000) for ordinary sectional work, is regarded as a maximum allowance under any system professing to give reasonably accurate results.

The statements made by Mr. Calder in the letter above referred to, may be fairly summarised as follows:—

1. That Tasmania is so densely wooded and rugged that it is impossible to adopt a really accurate and scientific system of survey, and its peculiarities "will for ever enforce peculiar modes of surveying."

2. That the setting aside of the compass meridian in favour of the True Meridian would, on account of obstructions, involve a "delay of several hours a day in the frequent determination of the True Meridian, which would be required of the surveyor, in many districts, every time the boundary line ran into a tree too massive to be removed."

3. That "trees are not to be passed by without liability to error;" and that he has found in practice no "better method of mastering the difficulty than that of observing the compass bearing of the line at the point of obstruction, and then proceeding in the same direction from its opposite side. By this process the error is not an increasing one, and though

pretty often repeated in a day's work, will generally not exceed half-a-dozen yards in a mile."

4. That the great errors existing in the maps are really errors of compilation in the office, and not errors of survey in the field.

5. That it is not desirable to undertake the reconstruction of the maps.

6. That the trigonometrical survey executed many years ago was a fraud, and entirely unreliable.

7. That "in the days of field survey inspection" the work of nineteen-twentieths of the surveyors "stood the severest tests that could be applied to it."

It will be convenient to consider these points *seriatim*.

1. Densely-wooded and rugged country.—It is better to show what has been done in other countries, than to advance mere theories; and it can be proved that these obstacles are by no means insuperable. In New Zealand there is to be found as densely-wooded and rugged territory as any that has ever been surveyed in Tasmania, and yet it is found practicable to apply an accurate system throughout. Extracts from the Annual Reports (1880) of some of the chief surveyors will furnish evidence in support of this statement.

The Chief Surveyor for Auckland district says:—"We have in hand at this time 23,000 acres, all of which is situated in the most broken, mountainous, and difficult part of this island." The work of some of the surveyors is "situated in the densely-wooded and precipitous mountains of the East Cape. . . . I wish to state my opinion, based on a $3\frac{1}{2}$ years' trial, that the system of survey . . . has been found to work as well in our forest-clad, broken country of the north, as in the open plains of the south."

In the Wellington district the sectional surveys, amounting to over 93,000 acres, are stated to be "all under forest."

The Chief Surveyor for Nelson speaks of the country, in which a large part of the surveys during the year were situate, as "rugged, mountainous, heavily-timbered, with dense undergrowth," and adds, "the bulk of applications to be surveyed are in isolated sections, or in small groups . . . in many cases only accessible by rough bush packtracks. . . . . Mining surveys in several localities are 3,000ft. and 4,000ft. above sea-level, and generally in bush on rugged mountain sides."

Referring to a portion of the triangulation in Otago, the chief surveyor for that district says, "This work is spread over 30 miles of wild Alpine country, full of bush, and intersected by dangerous snow-fed rivers."

Of the surveys in Southland, the report states that "50 sections, embracing 4,500 acres, were in bush. . . . The gold-mining applications were in densely-timbered broken country."

Enough has been quoted to dispose of the first point advanced by Mr. Calder.

2 and 3. Bush lines and meridian.—One would be led to infer, from the statements made, that the prismatic compass, or the compass attached to the theodolite, afforded the only available method of obtaining the bearings or azimuths of lines, whereas it ought to be taken for granted, as a matter of course, that even in the case of a survey, based upon an independent magnetic meridian, the initial line of the survey was the only one observed by the compass, the bearing thus obtained being transferred to the plate, and all subsequent readings derived therefrom. To whatever meridian the work is done, or from whatever source derived, whether compass or astronomical, the veriest tyro must be aware that the bearings are carried on by the theodolite, and that the proof of accuracy is found in the extent of accordance in the closure, either upon one of the lines of the survey in hand, or at a trigonometrical station. The argument advanced has therefore no foundation either in theory or in practice. If it has been in any degree the practice to make surveys by compass only, it ought to be no matter for surprise if the discrepancies in the various surveys are found to be startling. Still less should those discrepancies be a matter for surprise when we have an authoritative assurance that the most favourable results have been obtained from such a process as running a line by compass bearing to some large tree, and then, after transferring the instrument by guess to a supposed corresponding point on the other side, carrying on the line again by compass bearing; and this not only in an isolated case, but "a dozen or twenty times in every mile." It is also urged that by the mysterious correction of "compensation" the error "will generally not exceed half-a-dozen yards in the mile." Admittedly, therefore, the error may in some cases be much greater; but even what is considered a favourable instance depends entirely upon chance or luck. The errors, it is said, compensate each other to a great extent; but it needs hardly to be stated that the errors may be all the one way—all in the same direction—and then instead of the compensation of errors bringing the net error down to "half-a-dozen yards in the mile," the error may be increased indefinitely.

4 and 5. Errors in maps.—The statements made under this head only furnish an additional condemnation of the system in force. If the surveys are not trigonometrically connected and homogeneous, it is impossible to construct correct general maps, and it need be no matter of surprise that the draftsmen should have failed in the task assigned them, and that the maps are inaccurate. The reconstruction of the maps could only be undertaken, with any hope of placing them upon a more

satisfactory basis, concurrently with or subsequent to the field determination of the true relative positions of a number of points in the several districts.

6. Former triangulation useless.—This assertion, even if established, in no way detracts from the advantages of a trigonometrical survey honestly done, and reliable as a basis of detail operations. Nor is there anything in the nature of such a survey to make it a matter of uncertainty or speculation. If funds are forthcoming, the result ought not to be problematical.

7. Field inspection.—It would be interesting to learn what extent of surveys were rejected or condemned "in the days of field inspection." As the "severest tests" recognised a limit of error of 32 links in the mile, the standard of accuracy can hardly be considered high. To keep within the limit specified was one of the conditions of each surveyor's work, and it is obvious, therefore, that only those surveys which were found on traverse inspection to exceed this limit could be condemned. But, further, as there was no triangulation by which to test the surveys on inspection, the inspector's own work would have to be discounted somewhat, and allowing that officer a limit of error of 8 or 10 links in the mile, as it would only be a traverse inspection, it is not beyond the bounds of possibility to assume that he might pass work which was erroneous to the extent of something like 40 links in the mile, or 4in. in every chain.

Apart from general considerations as to the wisdom and propriety of establishing an accurate system of survey, the fact that under the Real Property Act titles are issued for certain pieces of lands, the boundaries whereof are defined in the certificates and guaranteed, renders it not only desirable but essential that the methods of survey and of record should be such as to effectually guard against overlaps of boundaries and consequent future claims and litigation.

A DESCRIPTION OF THE REMAINS OF TRILOBITES FROM THE LOWER SILURIAN ROCKS OF THE MERSEY RIVER DISTRICT, TASMANIA.

By R. Etheridge, Jun., F.G.S. (of the Museum of Natural History, London.)

[*Read* 13*th June*, 1882.]

I am indebted to the kindness of Mr. T. Stephens, M.A., F.G.S., for an opportunity of examining the fossils which form