character by which it differs from existing *Lacertilia* is the structure of the fifth digit of the hind foot, in which, however, it departs from all known Lacertilian reptiles, whether recent or fossil.

It is most interesting to observe that *Telerpeton* presents not a single character approximating it towards the type of the Permian *Protosauria*, nor to the Triassic *Rhynchosaurus* and other (probably Triassic) African and Asiatic allies of that genus*, nor to the Mesozoic *Dinosauria*; still less can it be considered a "generalized" form, or as, in any sense, a less perfectly organized creature than the Gecko, whose swift and noiseless run over walls and ceilings surprises the modern traveller in warmer climates than our own†. And whether the age of the deposit in which it occurs be Triassic or Devonian, *Telerpeton* is one of the most astonishing examples within my knowledge of a *persistent type* of animal organization.

2. *On a SECTION at LITCHAM affording evidence of LAND-GLACIATION during the earlier part of the GLACIAL PERIOD in ENGLAND.* By S. V. WOOD, Jun., Esq., F.G.S.

THE structure of the Lower Drift, and the limited area to which it is confined, conspire to show that this country first encountered, and for a long period sustained, the glacial conditions while principally in the state of land; for not only do the limited superficial extent of the formation and its rapid attenuation in all directions, from its great development on the Cromer coast, necessitate an inference that only a small part of England was under water at the time of the deposition of the Lower Drift, but the great masses of chalk and chalky débris that were carried into the marine sediment require us to admit the presence, near at hand, of some terrestrial chalk-area from which these masses were detached; and I imagine that it does not require any illustration here to satisfy geologists of the fact, so obvious from the appearance of the Cromer Cliffs, that much of the chalk of Norfolk was, at the time these masses were imbedded, occupied by a great glacier, from whose seaward termination they were carried and dropped into the marine sediment.

In such a state of things we should naturally look for some evidences inland of the terrestrial glaciation which this structure involves.

The beds in section on the Cromer Coast, forming the Lower Drift, although of so great a thickness there, alter, as I have elsewhere shown, both in their appearance and thickness inland.

* The anterior tusk-like teeth are comparable to the anterior teeth of *Rhynchosaurus* and *Dicynodon*, only so far as these are comparable to the like teeth of many existing Lizards, e. g. *Uromastix* and *Hatteria*.

† Dr. Mantell suggested that, should the lacertian relations of *Telerpeton* be established, it probably differed but little in its physiognomy and economy from the small existing terrestrial Lizards.

South-eastwards, in the direction of Norwich and the Yare Valley, the Lower Drift, or at least the upper or contorted part of it, passes into a fine brickearth, which exhibits no evidence of anything like terrestrial conditions; but westwards and southwestwards, it rapidly assumes the condition of chalky loam, often very finely stratified or laminated. In both directions it attenuates to less than a tenth of the thickness which it possesses on the coast, and, in both, passes under the thick formation of the Middle-Drift sand, appearing only where the valleys cut down to it.

Proceeding in the direction of Litcham, we lose sight of it altogether under the Middle Drift, that formation also eventually disappearing in this direction under the Upper Drift, or wide-spread Boulder-clay.

On encountering the Lower Drift, in its form of chalky loam, again at Litcham town, we find that the Middle Drift has disappeared in the interval, the Upper Drift resting directly on the laminated loam, as is the case also towards Weasenham and Swaffham, although a small tongue of it runs in again immediately on the south of Litcham. Fig. 1 shows the manner in which the Lower Drift recurs at Litcham town.

Fig. 1.—Section of Litcham Hill.

Now the condition of the Chalk over which this attenuated representative of the thick beds of the Cromer Coast occurs, is one of much interest, as it seems to afford clear indications of the passage over it of a glacier, and to connect itself with the phenomena of the transported chalk-masses of the coast.

I should premise that over much of Norfolk, under the Drift-beds, and even, in some degree, under the Fluvio-marine Crag itself, the chalk presents an appearance quite dissimilar to that exhibited by it in the south of England (where it was protected during the Glacial period by its covering of Lower Tertiaries), and for some 15 or 20 feet from its surface is in the impure condition which gives rise to the local term of "Marl" given to it in Norfolk. This condition seems to indicate that a churning up of the surface of the chalk has been effected by some action which permitted it again to subside without any considerable intermixture of foreign ingredients; and it is very dissimilar to anything we know to result, or can by geological phenomena gather to have resulted, from water-action. Now not

only is the condition of the upper 15 or 20 feet of the chalk in the section at Litcham, upon which the Lower Drift rests, such as this, but the state of the flint bands there indicates that great disturbance has taken place by a force acting *downwards from the surface*, and becoming less powerful the deeper the section descends. This is best displayed in a part of the quarry where the Lower Drift has, by the postglacial denudation which gave rise to the gravel (*d*), been removed; but although such is the case, it is sufficiently clear from similar although less striking features in the adjoining quarry, where the Lower Drift occurs, that this force was exerted before that formation was spread over the chalk. By the section (fig. 2) it will be seen that, of the bands of flint, only the lowest is perfect in its continuity, the others having been ruptured by some force not exerted from below, and whose intensity diminished downwards; and that this lowest band, although not ruptured, indicates, by its upward curvature under the spot where the bands which overlie it are ruptured and destroyed, that it has sustained in a less degree that dragging towards the surface which has been powerful enough to shatter altogether the bands above it. In the body of the chalk also are galls or cavities filled with dark-brown clay. These galls are not sections cutting obliquely across pipes or potholes, which are so common where the chalk or other soft limestone strata have been subjected to the Postglacial denudation, and into which the bed immediately over them commonly descends, but are cavities filled with some material quite foreign to the present superincumbent strata. Pipes, or potholes, of the well-known kind do, in fact, occur in the adjoining quarry, and are of great dimensions, passing completely through the thin bed of Lower Drift exposed there, and thence through some 20 feet of chalk. These, as is usual in similar cases, are filled with the gravel (*d*); but to them the galls of clay shown in the section have no relation.

Fig. 2.—Section at Litcham Lime-kiln.

- a.* Chalk with flint bands, becoming gradually more impure upwards, and the flints becoming detached and scattered in the upper part, about 20 feet. *d.* Coarse red Postglacial gravel. + Galls of dark-brown clay.
N.B. The lines of shading indicating the chalk in the *upper part* of the section are not to be regarded as lines of stratification.

Closely resembling the chalk in this section, are several of the

transported masses imbedded in the contorted Drift of the Cromer coast, especially that in which the limekiln is worked under Cromer Lighthouse,—galls of dark sand occurring in it there, as those of clay do here.

To what precise action these galls are due, or what the clay is that fills them, it is difficult to say; but the appearance of the section impresses me strongly with the conviction that we have here evidence of the passage of a glacier over the surface of the chalk,—the adhesion of the base of this glacier, in places, to the saturated chalk, caused by means of the intense congelation, having, during the glacier's onward motion, dragged up the chalk until the cohesion of the chalk itself balanced the dragging action, and the mass parted. Connecting this section with the masses seen in the contorted portion of the Lower Drift on the coast-section, we seem to see the process under which these masses were dragged from their matrix, and carried onward to the sound into which the glacier disembogued. It is probably in the retirement of this glacier before the increasing warmth which ushered in the Middle-Drift period, that this thin bed of Lower Drift, which spreads over so much of Central and West-central Norfolk, had its origin, the streams of chalky silt which the grinding of the glacier over its bed produced having been spread out as the glacier receded*.

In speaking of a glacier, I do not refer to any such as those occurring in mountain-regions, but to one enveloping the whole surface of the country, as described by Dr. Sutherland, and now covering the land around Baffin's Bay†. The distribution of the three divisions of the Drift seems to show that much of the centre and south-west of Norfolk was, during the Lower-Drift period, the seat of this capping glacier, and that its principal seaward termination was in the direction of Cromer, where the bulk of its moraine was spread out under the sea, the finer silt being carried south-eastwards to form the brickearth continuation of it which stretches as far as the northern border of East Suffolk, and that much of the seat of this glacier, from its more elevated position, remained above water during the whole Middle-Drift period, only passing under the sea when the great submergence of the Upper-Drift (*c* of fig. 1) or true Boulder-clay period set in.

3. *On the Existence of a THIRD BOULDER-CLAY in NORFOLK.*

By F. W. HARMER, Esq.

[Communicated by Searles V. Wood, Jun., Esq., F.G.S.]

(Abridged.)

THE deposit which is the subject of this paper is shown in a pit near Trowse junction, a mile to the south of Norwich. It consists of a

* In this view the inland bed (*b* of sect. 1) would only represent the very uppermost part of the Contorted Drift of the coast, the rest of that Drift, as well as the subjacent Boulder Till, being represented by the glaciated land-surface.

† Quart. Journ. Geol. Soc. vol. ix. p. 301.