formly employed flint knives in sacrificing animals, and for circumcision. From this absence of all reference to flint or stone weapons in the earliest writings of the Welsh, it seems to follow, either that the writings cannot be depended upon to supply precise information, or that the men who made the flint weapons were of another race, possibly much earlier inhabitants of the island.

Thirdly, whence was the material obtained? There are no flints in the formations and strata of the vicinity,—that is certain. But then they may be picked up any day by a careful search on the shore; and so may granite boulders and worn fragments of igneous rocks.

The chert of these implements is peculiar. It is of a dull, opaque green colour, full of minute grey spots. I do not at present know of any like it in these parts; but one lump, tide-borne to the coast, would have supplied all required for the sixteen fragments of this kind found.

CORRESPONDENCE.

Age of the Blackdown Greensand.

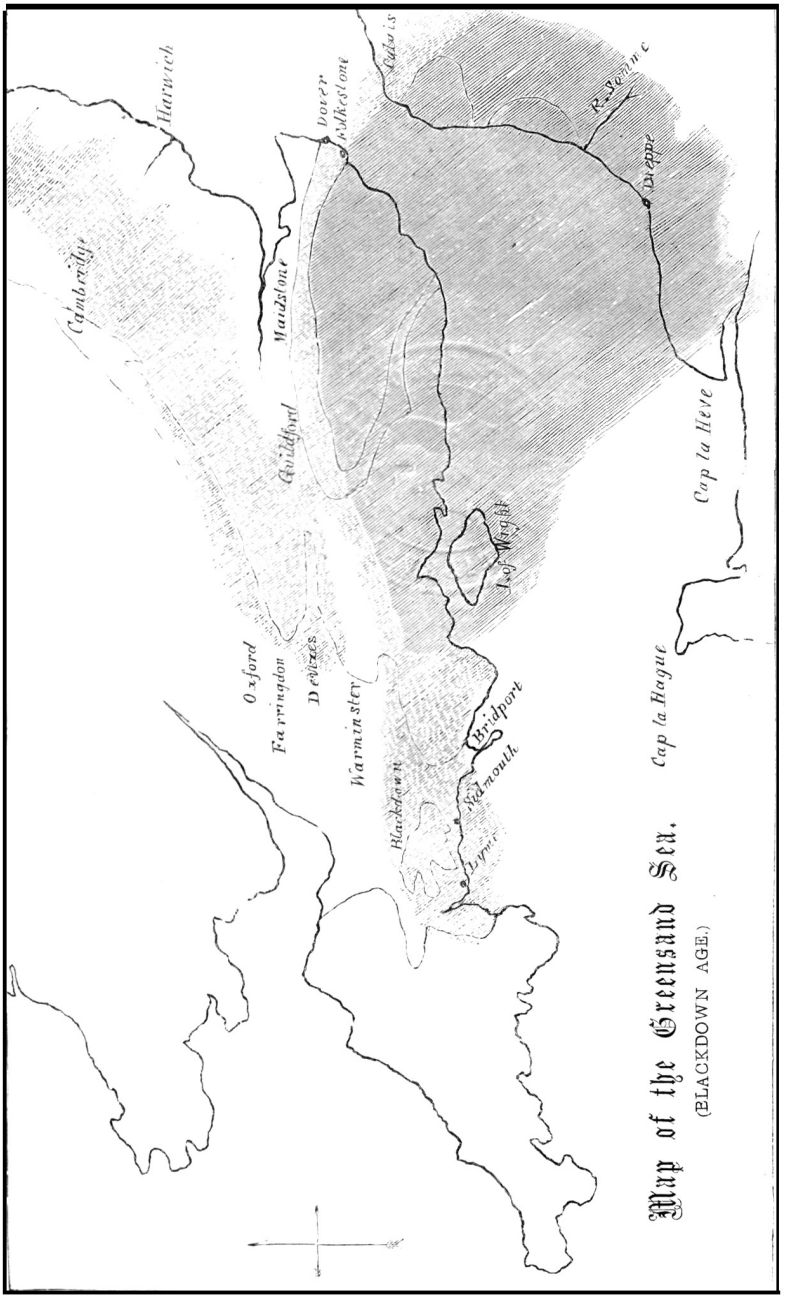
Sir,—The question as to the true position in the Greensand series of the "Whetstone" deposits of Blackdown, in Devonshire, is one which, so long as it remains uncertain, must naturally force itself upon every geologist who either studies or collects the fossils of the Greensand formation; and, therefore, although this question is neither new nor of universal importance, I trust that I may be permitted to refer to it in the present instance.

The question is simply this—Are these (Blackdown) deposits equivalent to the Upper Greensand, to the Gault, or to a portion of the Lower Greensand? or do they represent the whole of these in an exceptional form?

In parts of Kent or Surrey, where the Lower Greensand strata rest upon Weald clay, and are everywhere separated from those of the Upper Greensand by an intervening bed of Gault, such a question would be readily determined. But at Blackdown the case is different, the Greensand being there found to rest upon red marl, and the Gault either absent or imperfectly developed; so that, in default of the usual direct evidence, the geologist must be content with such indirect conclusions as can be drawn either from the general appearance of the deposits or from a comparison of the organic remains with those contained in other portions of the Cretaceous series. Whether or not this last method has been carried out by those who consider the Blackdown deposits to be of Upper Greensand age, I have not hitherto been able to ascertain.

In the British Museum all the Blackdown fossils are marked as Upper Greensand, in the Museum of Practical Geology, more cautiously, as Greensand; while in both they are ranged side by side with fossils from Warminster,—a locality where the Upper Greensand is well defined by the presence of the Gault. Now, supposing Upper Greensand deposits to prevail equally at Blackdown and Warminster, one might expect to find a considerable resemblance between the fossils from these two localities; yet, on comparing the specimens, the fact proves itself to be quite the reverse; for, at a rough computation, I find that out of 156* Blackdown

* These and the following numbers refer to Mollusca only.



Map of the Greensand Sea.

(BLACKDOWN AGE.)

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species of mollusca, 6 only occur at Warminster, the remaining 30 Warminster species not being found at Blackdown. A further comparison of the Blackdown fossil mollusca with those of the Upper Greensand generally, and also with the fossil mollusca of the Gault, gave nearly the same result.

These observations, combined with certain facts which came under my notice while studying the Lower Greensand of Surrey and the Isle of Wight, led me, in the first place, to question the correctness of classing the Blackdown deposits with those of the *Upper* Greensand or even of the Gault; and ultimately induced me to believe them, so far at least as the whetstone strata are concerned, to be exclusively of Lower Greensand origin—their position in the series being, probably, near the base of the upper or ferruginous division of Fitton.

It is, therefore, in the hope of stimulating further inquiries, which, for myself, I have neither the time nor the opportunity to make, that I now venture to address you on the subject, as I feel convinced that a closer investigation of the lowest beds of the Greensand at Blackdown must now decide the question; for, should the absence of Gault be confirmed, I think the evidence of the fossils alone may be deemed conclusive.

The following table shows the relation of the Blackdown fossils to those of the Upper Greensand, Gault, and Lower Greensand respectively:—

Total number of Blackdown species (Mollusca) taken from 'Morris's Catalogue, Fitton's List in Trans. Geol. Society, and from specimens in the British Museum and Jermyn Street Museum, 156. Of these, 81 are peculiar to Blackdown; 20 occur in Upper Greensand, 7 of which are limited to Upper Greensand and Blackdown; 16 occur in Gault, 4 of which are limited to Gault and Blackdown; 59 occur in Lower Greensand, 39 of which are limited to Lower Greensand and Blackdown.

The numbers for comparison, therefore, stand thus:—

Species limited to Upper Greensand and Blackdown, 7; *viz.*—

Ammonites denarius . .	Not common (Sow.).
A. falcatus	A rare species (Sow.)
Pecten asper	Abundant in G. S. near Frome.
Terebratula lyra . . .	Rare.
Turritella granulata . .	Abundant at Blackdown; U. G. S., locality doubtful.
Gryphæa vesiculosa . .	Abundant in U. G. S., near Warminster; Blackdown, doubtful.
Cucullæa carinata . . .	Common at Blackdown; occurs in U.G.S., near Devizes.

Species limited to Gault and Blackdown, 4; *viz.*—

Ammonites auritus . . .	Not common (Sow.).
A. tuberculatus	
Murex calcar	Common at Blackdown; other localities doubtful.
Rostellaria calcarata . .	Common at Blackdown and Folkestone.

Species limited to Lower Greensand and Blackdown, 39; *viz.*—

	Lower Greensand locality.	
Astarte formosa . . .	Shanklin	Rare.
A. obovata	Sandown.	
Avicula Rauliniana . .	Godalming.	
Cardium Hillanum . .	Shanklin	Frequent.
Corbula truncata . . .	Peasemarsh	Common.
C. elegans	Peasemarsh	Common.

Cucullæa glabra . . .	Shanklin and Peasemarsh .	Rare.
Cyprina angulata . . .	Hythe and Sandgate.	
C. rostrata	Atherfield.	
Cytherea (Venus) caperata	Atherfield.	
Venus faba	Shanklin and Peasemarsh .	Common.
V. ovalis	Peasemarsh	Rare.
Exogyra undulata . . .	Godalming	Rare.
Gervillia anceps . . .	Peasemarsh.	
G. lanceolata	Atherfield.	
G. solenoides		
Lima semisulcata . . .	Shanklin	Common.
Nucula antiquata . . .	Atherfield.	
N. impressa	Parham Park.	
N. lineata	Shanklin.	
N. obtusa	Atherfield.	
Tellina inæqualis . . .	Shanklin and Peasemarsh.	
T. (Psammobia) striatula	Shanklin and Peasemarsh.	
Thetis minor	Shanklin and Peasemarsh .	Common.
Trigonia dædalæa . . .	Parham Park.	
T. spectabilis		
T. caudata	Atherfield.	
Littorina pungens . . .	Peasemarsh.	
L. conica	Peasemarsh and Shanklin .	Common.
L. (Natica) monilifera .	Peasemarsh	Rare.
L. (Natica) rotundata .	. . . . .	Common.
Phasianella formosa . .	Peasemarsh	Rare.
P. striata	Peasemarsh	Rare.
Turbo munitus		
Nautilus elegans . . .	Godalming.	
Dentalium medium . . .	Peasemarsh.	
Serpula filiformis . . .	Shanklin.	
S. plexus		
Vermetus polygonalis . .	Hythe and Sandgate.	

From the above list, it is apparent that the Upper Greensand and Gault fossils which occur at Blackdown are but few, and of small value when compared with those of the Lower Greensand.

There are circumstances connected with the accumulation and deposition of the strata forming the Lower Greensand generally, which may also be taken into account in considering this question; some of which I shall now proceed to notice.

It has been shown by Dr. Fitton, that the Lower Greensand, wherever fully developed, is separable into three groups or series of strata; each differing somewhat from the others in mineral character, and each possessing a fauna more or less peculiar to itself. Now, although the limits of each are not everywhere traceable, yet there is always a sufficient distinctness between them to warrant the belief that the same causes, whether of upheaval or depression, acted throughout the entire British area then covered by the Greensand ocean.

In the neighbourhood of Godalming this subdivision is, perhaps, more strongly marked than is usually the case. The lower Neocomian clays are here found, as elsewhere, resting conformably upon the Wealden. They are succeeded by a series of strata, composed, for the most part, of fine sand, mingled with more or less argillaceous matter, and including occasional bands of loose, concretionary sandstone; this latter being, apparently, a local equivalent of the Kentish rag of Maidstone. All these appear to have been deposited quietly and continuously, and form, includ-

ing the lower Neocomian clay strata, "the Middle and Lower division" of Fitton.

Here, however, there is an abrupt change. The finely stratified deposits which have hitherto prevailed are overlaid by an accumulation of coarse sand and *pebbles;* the stratum or strata composed of these materials varying in thickness from a few inches to six or ten feet, and contrasting strongly with the sands beneath. The "pebble-beds" are succeeded by various strata of coarse gritty sand, abounding in concretions of limestone* and chert; in all of which small pebbles and thin layers of clay are of frequent occurrence. These, in turn, are followed by a series of ferruginous sandy deposits of considerable thickness, which range upwards uninterruptedly to the Gault.

It is to the occurrence of these "pebble-beds" and of the superincumbent limestone, in the Greensand of Godalming and elsewhere,† that I would now direct attention, as being possibly connected with the present subject of inquiry.

There is another subject, however, so closely connected with every question relating to the Greensand, that I find myself compelled to notice it before proceeding further.

Mr. R. Godwin-Austen, in a valuable paper "On the possible Extension of the Coal-measures beneath the South-Eastern part of England,"‡ argues the existence, during the Oolitic, Wealden, and Neocomian period, of a *ridge of old rocks* (palæozoic) extending across our south-eastern counties nearly in the line of the North Downs. This ridge the author traces eastward, in connection with a well-marked Continental axis, called by him the "Axis of Artois," and westward, into the district of Bath and Frome. For the capital reasoning upon which that author's supposition is founded, I must refer the reader to the original paper. Yet it cannot fail to strike the observer, that such a ridge, supposing it to have existed as a coast-line during a lengthened period, must have exercised considerable local influence upon the surrounding deposits, whether of the Oolitic or Cretaceous formation; so that the surrounding deposits ought, in themselves, to contain some direct proof of its existence. Such proof, if I mistake not, may really be found in the "pebble-beds" of the Lower Greensand. Of these, Mr. Austen says, "The shingle-beds of the Lower Greensand of Kent and Surrey contain a considerable number of extraneous fossils, such as the bones and teeth of Oolitic saurians, *Ammonites Lamberti* and *Am. crenatus* of the Oxford clay in great abundance, together with *Terebratula fimbria* and *Rhynchonella oolitica;*" and instances these as having been derived from the wearing away of members of the Oolitic group, which, he suggests, may have been originally brought up against the southern slope of this old ridge "by a process of successive overlap."

In confirmation of this opinion I may here mention that, previously to becoming aware of Mr. Austen's researches, I had obtained from the "pebble-beds" of the Lower Greensand of Godalming a series of drifted fossils, ranging in age from the Oxford clay to the Lias inclusive; and, from the evidence of these alone, I had come to the conclusion, that at the time of their deposition in the Greensand the rocks from whence they were derived must have existed within a short distance to the northward.§

* Locally called "Bargate stone."

† Along the North Downs. A pebble-bed also occurs in the cliff north of Shanklin chine, holding exactly the same position in the Greensand.

‡ Quar. Jour. Geol. Soc. vol. xii. p. 50.

§ My reason for looking northward for such land-surface arose partly from the fact of the pebble-beds becoming gradually thicker, and their component parts coarser, in that direction.

In addition to the fossils mentioned above, I have collected from these "pebble-beds" specimens of the teeth of—

Saurichthys apicalis . .
S. Mougeoti . . . . . } Fossils of the Trias of Aust cliff and
S. ? . . . . . the Lias bone-bed at Axmouth.
Hybodus Minor . . . .
Acrodus minimus . . .
Hybodus pyramidalis . . } Fossils of the Lias.
H. reticulatus . . . . .
H. grassiconus.
H. ?
Lepidotus (two or more species in abundance).
Sphærodus ?
Gyrodus.
Pycnodus Mantelli.
Acrodus.
Strophodus ?
Lamna longidens.
Notidans.

and some others. The greater number of these specimens are more or less broken; yet many of them are by far too perfect and delicate to have been drifted from a distance. I have also, from the same deposits, casts of about thirty species of small univalve and bivalve shells, which, at present, I have had no opportunity of identifying.

The "pebble-beds," therefore, appear to offer double evidence in regard to this "old ridge:" firstly, in affording a proof of its existence as a coast-line; and secondly, in pointing out a time of its partial submergence: with the latter evidence I have now to do.

A thin stratum of sand, clay, and *pebbles* (described by Fitton as a "kind of gravel"), occurs at the base of the Lower Greensand, at its junction with the Wealden. Again, the basement-bed of the Gault, as at Redcliffe, contains numerous *subangular pebbles*. In both of these cases the pebbly strata represent a change in the relative level of land and water, sufficiently extensive to have altered the character of the succeeding deposits; and thus it seems probable that the "pebble-beds" at the base of the upper division of the Lower Greensand represent a similar disturbance; the effect of which, I think, may be easily traced.

No Greensand deposits older than the "upper" or ferruginous division of Fitton are found to the west of a line drawn from Warminster to the Isle of Purbeck, or north of a line passing from Dover, through Rochester, Croydon, Kingsclere (Hants), and then on to Warminster, or, in other words, north of Godwin-Austen's "old ridge." Greensand deposits, however, corresponding to Fitton's upper division, are found greatly to exceed these limits, both on the north and west. It appears, therefore, to be tolerably certain that the "pebble-beds" at the base of the ferruginous division represent, and are the immediate result of, a period of considerable depression, during which the Lower Greensand ocean extended itself far to the northward, across a portion of the "old ridge," and westward into Devonshire. By supposing this ridge to have been cut through or partially submerged at this period, one difficulty, at least, as regards the "pebble-beds," will be done away with—viz. that of the occurrence in one stratum of the fossils of several separate formations. For, supposing such a ridge to have existed as a land-surface from a period prior to the deposition of the Lias, every succeeding deposit must have been brought up against it, as has been suggested by Mr. Austen; and, consequently, an oceanic current, in

crossing this line, would act upon the edges of these various deposits, and thus mingle in one stratum the débris of many. It would, further, serve to connect the "pebble-beds" of Surrey with similar deposits in the Lower Greensand near Devizes, and also with such part (at least) of the Faringdon gravels as are generally recognized as of Lower Greensand age. The mineral character is the same in each, and the fossils are also found to bear a close resemblance. The "pebble-beds" of Godalming contain *Rhynchonella depressa*, *R. latissima*, *R. nuciformis*, *Terebratula Nerviensis*, *T. oblonga*, *T. faba*, *T. ovata*, (?) *T. tamarindus*—the first four rarely, the latter in abundance; all of which species have been found at Seend, near Devizes, and also at Farringdon.

To the first part of this argument—viz. a northern, or rather north-eastern, extension of the Greensand at this period, no objection is likely to be made. A western extension at the same period, however, does not so readily admit of proof; yet it is so very probable, that, for the sake of argument, I will suppose the fact to be admitted. In which case, the lowest beds of the Greensand in Dorset and Devonshire would be nearly equivalent in age to the "pebble-beds" of Godalming; and the position of the "Whetstone" beds of Blackdown, from which the greater portion of the Blackdown fossils are obtained, would correspond with the concretionary, siliceous, and calcareous deposits which so frequently occur near the base of the ferruginous division of the Lower Greensand of Kent and Surrey, etc. As, for instance, the concretions in the cliffs between Folkestone and Copt Point, described by Fitton as "in part consisting of siliceous, spongy stone, like the Whetstone of Devonshire;" the Bargate stone of Godalming, in which siliceous, spongy concretions also occur; the siliceous and ferruginous concretions in the cliff, which form the upper part of Shanklin chine, and the ferruginous nodules in the Greensand at Parham Park. The fossils from these localities, though few in number, are mostly such as occur at Blackdown. Thus, from the Bargate stone of Godalming, in which shells are very scarce, I have obtained *Avicula Rauliniana*, *Exogyra undata*, and *E. undulata*; from Shanklin, *Astarte formosa*, *Cardium Hillanum*, *Psammobia striatula*, *Tellina inæqualis*, *Gervillia lanceolata*, *Thetis minor*, *T. lævigata*, *Venus faba*, *Lima semisulcata*, *Nucula impressa*, *N. lineata*, *Pecten quinquecostatus*, *Pinna tetragona*, *Corbula elegans*, *Trigonia caudata*, *Littorina conica*, *L. monilifera*, and *L. rotundata*. In fact, these last-named deposits contain a greater percentage of Blackdown fossils than occur in any other portion of the Cretaceous series; and this, alone, is in itself the strongest argument which could be used in favour of the Lower Greensand age of the Whetstone deposits.

In the accompanying map I have endeavoured to show the probable position of land and water at two distinct periods: the darker shading represents the probable extent of the greensand ocean over our south-eastern counties during the accumulation of those deposits which are included in Fitton's middle and lower division; the lighter shading exhibits its further extension to the north-east and west, during and after the accumulation of the "pebble-beds," and previously to the deposition of the Gault.

In this map Mr. Godwin-Austen's "old ridge" forms the northern boundary of the Greensand during the first period. At the second period the greensand is seen on the north—the ridge being partially submerged. It is probable that this ridge became wholly submerged during or immediately before the deposition of the Gault.

Allowing the position of the land-surface to have been as above stated, the abundance of the Blackdown fossils, as compared with those in the upper division of the Greensand in Surrey, etc., would not be at all sur-

prising; for the position of Blackdown, near the end of a narrow inland bay, would have been, of all others, the most favourable one for the increase of mollusca.—I am, Sir, yours, etc., C. J. A. MEYER.

Godalming, Surrey.

Elephas Texianus v. *Columbi.*

SIR,—Reference has already been made by me to the above subject in the pages of the 'Geologist.'* The nomenclature which I have used, and the inferences which I have drawn, having been impugned in an elaborate paper by Dr. Falconer,† a few lines in their justification may be permitted.

When, in February, 1858, the tooth in question was shown to me by my friend Mr. Bollaert, the most casual observation was sufficient to demonstrate that it was of a different species to the Mammoth (*E. primigenius*). In the dearth of published information on the subject I consulted the works of Cuvier,‡ Humboldt, § Leidy, ‖ De Blainville,¶ Carpenter,** Lartet,†† and others, and especially the memoir of Dr. Falconer.‡‡ I endeavoured in the paper on the Texan Elephant to acknowledge the benefits to proboscidean science derived from his "most complete, elaborate, and philosophical conspectus."

Upon attempting, with the "Bollaert molar" in my hand, to discover in this memoir any specific description of this form, my efforts resulted in disappointment. Dr. Falconer, in the above-cited memoir, divided his subgenus *Euelephas* into four divisions. The first he characterizes as having "*Colliculi subremoti, adamante crassiusculo.*" The solitary species belonging to it is the Miocene *E. Hysudricus*. The second division (*Colliculi approximati, medio leviter dilatati, machæridibus undulatis*) includes *E. antiquus* and *E. Namadicus*. The third division (*Colliculi approximati, machæridibus valde undulatis*) includes *E. Columbi*, *E. Indicus*, and *E. Armeniacus*. The fourth division (*Colliculi confertissimi, adamante valde attenuato, machæridibus vix undulatis*), has for its solitary representative the mammoth (*E. primigenius*).

The name *E. Columbi* has the following notes added to it in Dr. Falconer's Synoptical Table:—

Geological Age.	*Country.*	*Remarks.*
Post-pliocene?	Mexico.	An syn. *E. Jacksoni?*
	Georgia.	Sillim. Journ., 1838,
	Alabama.	vol. xxxiv. p. 363.

In the second part of his paper, which was read before the Geological Society on June 3, 1857,§§ Dr. Falconer concluded with a few remarks on the non-existence of *E. primigenius* south of the Alps, and its restric-

* Geologist, vol. iv. p. 470; vol. v. pp. 57 and 323.

† 'On the American Fossil Elephant of the Regions bordering on the Gulf of Mexico (*E. Columbi*, Falconer), with General Observations on the Living and Extinct Species.' Natural History Review, January, 1863.

‡ Ossemens Fossiles, ed. 1834, vol. iv. p. 145.

§ Cosmos, vol. i. p. 280.

‖ Nebraska Fauna, p. 9.

¶ Ostéographie, Eléphans, p. 157.

** Silliman's Journal, second series, vol. i. p. 244.

†† Bull. Geol. 1859, p. 469.

‡‡ Quarterly Journal Geol Soc., 1857, p. 319; 1858, p. 81.

§§ Quarterly Journal Geol. Soc., vol. xiv., 1858, p. 81.