

NOTES ON THE GEOLOGICAL STRUCTURE OF THE VALE OF KINGSCLERE.

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(I.) INTRODUCTION.

The geological structure of the South-Eastern Counties of England does not, as a rule, lend itself to the requirements of elementary students. Fascinating and baffling as are many of its problems, they are mainly concerned with elaborate topics demanding intimate study and special knowledge, or with features of structure or topography that cannot be appreciated during a visit to a restricted area. Wandering for miles along the irregular summits of degraded escarpments, and gazing across spacious areas of almost featureless dip-slopes, the teacher and the taught both come to long for the concise and sharply cut topography that characterizes the rocky hills of the marches or the open moors of the Pennines. Eagerly but vainly scanning the horizon and the Ordnance map for some trace of a section, one recalls with regret the deep ravine where the Bilston Burn tumbles from the Pentlands, or the cliffs where the surge of the Channel has scoured out a vast amphitheatre between Start and Portland. It is true that faults, folds, sections (in extreme moderation), and indeed almost all the stock features of an introduction to Geology (excepting the phenomena associated with vulcanism) are to be found, but they are usually so small in value or so obscure in result that, so far from defying the blindness of inexperience, their presence is often a matter of inference rather than observation.

Even the classic and majestic anticlinorium of the Weald is on too large and diffuse a scale to be comprehended from any single view-point; while the Isle of Wight, apart from its coastal sections, has but little tectonic variety to display.

It may be presumed that so sweeping and derogatory a reference to a large district will be challenged by many local exceptions, and more especially by local enthusiasts. In the present brief paper one of the latter rejoices in reviving his memories of one of the former. The vale of Kingsclere occurs as a kind of oasis in a desert of monotony (from the teaching point of view). Even on the Geological map it appears as a patch of verdant green in a grey or dun-coloured waste. In reality it possesses a peculiar charm, whether it be regarded with the eye of a Stratigrapher, a Physiographer, a Palaeontologist, or a Poet. To the north the tree-clad undulations of the Tertiary district slope irregularly towards the narrow valley of the Enborne, to rise abruptly in the flat, heather-covered plateau of Greenham Common. To the south the bare scarp of the Chalk downs, fretted and almost breached by deep, wooded combes, rears itself in a dull green wall, upon whose whale-backed crest a few gnarled trees stand out crisply against the sky. To the west the bleak sentinel of Beacon Hill affords a bold foreground to the plantations of Sidown and Highclere, beyond which the downs roll on to Inkpen. To the east Kingsclere nestles among its quarries in a chink in the wall that sweeps round from Cottington Hill by Plantation Farm. In the centre the twin domes of Isle Hill and its un-named western sister rise like islands chequered with fertile fields and crowned with trees, while in the northern trench of the Vale exquisite springs of clear water rise, to spread into the watercress beds of Ecchinswell or to drive the mills of Kingsclere.

The Didcot and Southampton railway crosses the Vale in its western part, and the cuttings thus made through this elevated region afford an almost continuous section of the rocks that build it. The northern rim is still scarred by numerous quarries, despite the frequency of large and beech-grown dells that tell of disused excavations. The central part of the Vale can boast of a

long and interesting road-side section trenched deeply into the side of Isle Hill, while the derelict, but still clean, section at the Burghclere Lime-works gives access to parts of the Chalk sequence that cannot be studied on the northern side. In one quarry, by Portridge Cottages, south of Hockley's Hole, and not far from the railway, it is even possible to see and measure the dip of the rocks, which is made conspicuous by the resistance of the Chalk-Rock to the degrading influence of the weather.

Structurally the Vale of Kingsclere is a dome or pericline, in which denudation, by removing the weakened and exposed rocks of the summit, has laid bare a complete sequence from the Bagshot series to the Selbornian. In this respect it resembles the Vale of Shalbourne, which lies below the bold escarpment of Inkpen a few miles to the west; but it has an advantage over the latter area in being smaller, more circumscribed in plan, more adequately exposed by quarries and cuttings, and more accessible by rail.

In the following pages no attempt will be made to describe the general features of the geological character of the Vale. These can be found sufficiently explained in the Geological Survey Memoir for the Andover District, and in papers and excursion reports in the Proceedings of the Geologists' Association. It is intended rather to publish certain facts which either correct or amplify the present knowledge of the Geology of the district, and to discuss, as far as is possible at present, the character of its tectonic structure in detail and in relation to its surroundings. To apply the sequel of this discussion to a consideration of the consequent land-forms and surface-drainage would unduly expand the paper, and would involve a trespass by a "general practitioner" into the jealously guarded estates of physiographical specialists.

(II.) STRATIGRAPHICAL NOTES.

(a) THE SELBORNIAN.

The Gault is nowhere exposed within the Vale; nor has it, so far as I am aware, been reached by any borings, although that at Burghclere Manor must have almost penetrated the overlying

Greensand. There can be no reasonable doubt that this belt of clay, the first really constant member of the Cretaceous series, does actually underlie the district. As to the nature of the next series in descending sequence, less confidence can be felt. In sheet 80 of the Horizontal Sections of the Geological Survey, H. W. Bristow inserted Kimmeridge Clay below the Gault, but the evidence for this is not apparent. Possibly the fact that this sequence occurs in the more northerly part of the same section (in the Vale of White Horse) may have influenced him. It is possible, and perhaps probable, that the Lower Greensand, which appears in such great development at the western end of the Weald, occurs beneath the Gault of the Vale, but there is no criterion whereby its thickness can be estimated. It is conceivable that some amount of Wealden deposits may be present in the area, but here again it is impossible even to suggest its bulk. The present writer is inclined to agree very cordially with the remark made by Mr. Whitaker (Royal Commission on Coal Supplies, part x., p. 42), to the effect that there is no telling what may be the rock-sequence under the district, and that a deep boring might be productive of startling and even profitable results. Further reference to this enthralling, but speculative, topic will be found in the last section of this paper.

The Upper Greensand covers a considerable area of the centre of the Vale, and its basest surface rises to nearly 550 O.D., on Isle Hill. Exposures in it are few, the only three of note with which I am acquainted being the railway cutting near Burghclere Station, a quarry in the side of a valley about a quarter of a mile W.S.W. of Werg's Farm (a few yards north of the Burghclere-Sydmonton road), and a long lane-section where the transverse road from Ecchinswell to Sydmonton Park combe crosses the western slopes of Isle Hill.

In the railway cutting at the northern end of the up platform of Burghclere Station, flaky and crumbling greensand is easily examined without any need for trespass. The sand is very glauconitic, and is full of the curious tubular, slightly phosphatic, calcareous concretions that are frequently found at this horizon.

Further along the cutting (in a northerly direction), rather lower beds are exposed, and these contain irregular seams of chert, though in bulk retaining the characters shown at the Station.

The small field-quarry a little to the east of the railway seems to have been opened for road-metal, the rock being fairly cherty. In 1909 (Proc. Geol. Assoc., vol. xxi., p. 174) Osborne-White refers to this quarry as having been visited on an excursion to Burghclere and Newbury. He records the finding of *Syncyclonema orbicularis*, an *Ostrea*, and Echinoid spines; and, while rightly recognizing that the beds are on a lower horizon than those of the railway-cutting, doubtfully refers the section to the zone of [*Mortoniceras*] *rostratum*. Both alone and with my students I have often visited this small quarry, and have collected a fair number of fossils from it. The evidence points definitely to the zone represented being that of *Aequipecten asper*, although the lower zone is probably not far below. Only one piece of the zonal index has been found, but it is quite distinctive. In addition to the abundant but non-committal *Syncyclonema orbicularis*, the two Echinoids *Discoides subuculus* and *Epiaster lorioli* are represented by one specimen each. (That of the latter species, which is rarely met with and usually poorly preserved, is an exquisitely perfect example.) One or two specimens of *Neithea quinquecostata* and some specifically indeterminable fragments of *Exogyra* complete the list. Although the other fossils are not absolutely distinctive of any particular zone, the two Echinoids seem, as far as is known, to be entirely restricted to the zone of *Aequipecten asper*, both occurring in all sub-divisions of the zone at Warminster. There is thus some reason to believe that the cherty beds exposed in this quarry correspond with the middle "Chert Beds" of Wiltshire, so that the softer series shown in the railway-cutting (from which a fair list of fossils is recorded by the Survey) may represent the "Highest Beds" of the west. In the Memoir on the Andover sheet evidence is given that these sands of Burghclere Station pass up gradually, through a kind of "Chloritic Marl," into the Lower Chalk, so that the above correlation is probably correct.

The third exposure, on the western slope of Isle Hill, shows a very regular alternation of bands of hard chert and soft greyish-green friable sandstone. I have not succeeded in extracting any definite evidence as to the zonal position of the beds exposed, but on lithological grounds there seems every reason to believe that they are a continuation of those shown in the quarry previously described. If this is the case, it would seem that, with the almost certain exception of the floor of the deep gully east of Sydmon-ton, the whole basisset-surface of the Upper Greensand is cut in the *asper*-zone. Hence the surface contours of the central part of the Vale cannot depart seriously from those of the underlying strata. The resistant character of the "Chert Beds" has checked the erosive action of the weather, producing a periclinal dip-slope in the middle of the dome.

At Burghclere Manor as much as 130 feet of "Sand and Rock" was penetrated by a well. The dips at that spot are apparently very slight, so that this must represent the minimum thickness of the Upper Greensand. This would imply that the Upper Greensand of the Vale of Kingsclere is almost identical with that of Warminster in bulk, while the foregoing remarks show that at least the two uppermost sections are essentially similar in texture and composition. The apparent absence of the *asper*-zone along the north-western border of the Weald makes this comparison interesting. In the Survey Memoir on the Selbornian (1900) Jukes-Browne remarks (p. 105) "It is evident that this zone [*P. asper*] comes in between Farnham and Kingsclere." Its full development in the latter district would seem to imply that the zone must extend very near to Farnham, and that it is only just missed by the excavation of the western part of the Weald. Since the oncoming of the higher division of the Upper Greensand appears to coincide with a reduction in the thickness of the lower part (*rostratum*-zone), which is more than 170 feet thick near Selborne, it seems likely that the total known thickness (130 feet) in the Vale of Kingsclere is very nearly the true one. If the absence of the Upper Gault be inferred by analogy with the Warminster district, and the development of the remainder be

supposed to maintain the similarity shown in the "Greensand" series, there would be some 220 feet of Selbornian present in our area. This total would be reduced by at least 100 feet in the Sydmonton gorge, so that a boring of less than 200 feet in depth in that valley might be expected to show whether the Lower Cretaceous rocks are present or not under the Kingsclere area.

(b.) THE CENOMANIAN.

The Lower Chalk is now exposed in only three localities, so far as I am aware. Of these, the railway-cutting south of Burghclere station is too badly sloped at present to supply any satisfactory evidence, while the large quarry of the Burghclere Lime-works is disused, though still showing a vertical face of some height. There is also a small quarry, very deep for its size, near Ivory farm, at the foot of Beacon Hill. Both the quarries expose massive grey chalk which is very poor in fossils. The only evidence of a zonal character that I have acquired consists of a fragment of *Discoides cylindricus* from the last-named pit. Both the quarries are, however, obviously in the zone of *Holaster subglobosus*. The "Totternhoe Stone" recorded in the Andover memoir as occurring in the railway cutting is now quite indistinguishable.

(c.) THE TUROÑIAN.

I know of no exposure (suitable for adequate study) of the zone of *Rhynchonella (Cyclothyris) cuvieri* in the environs of the Vale. The only places where the higher zone of *Terebratulina lata* is accessible are at Portridge and just south-west of Kingsclere. In the former quarry about 23 feet of soft chalk occur under the shelf formed by the Chalk Rock, but at the time of my last visit (September, 1917) it was entirely obscured by talus. I have never found any fossils in it.

(d.) THE SENONIAN.

There is nothing new to add to the accounts of the lower zones already published by the Survey and in the Proceedings of the Geologists' Association, while the higher zones have been so

thoroughly described by White and Treacher, and later by Brydone, that little remains to be recorded.

In one or two features, however, the qualities of the zone of *Micraster coranguinum* will bear more detailed description. The large quarry south of Whitway, which is referred to in most accounts of the Geology of the district, is one of the most satisfactory and extensive exposures of that zone available. About 80 feet of chalk (*fide* H. J. O. White) are shown, of which some 60 feet are below the *Uintacrinus*-band. The layer of small crushed specimens of *Conulus albogalerus* (?*globulus*), which is so marked a feature near the top of the *coranguinum* zone at Ecchinswell and as far east as the Isle of Thanet, is present in full character near the northern end of the pit, perhaps 30 feet below the highest beds exposed. At the Cowhouse Farm pit this well-defined band occurs about 10 feet from the top of the zone, so that there are probably 20 feet of the *Marsupites*-zone (*Uintacrinus*-band) exposed here. I have not found the ossicles of the characteristic Crinoid, but in view of the rubbly state of the chalk and the rarity of their occurrence further to the east, this is not surprising. Messrs. Treacher and White record *Uintacrinus* from this quarry, and hence there can be no doubt as to the presence of the zone. I follow the ordinary course of classing the *Uintacrinus*-band with the zone of *Marsupites* rather than with that of *M. coranguinum* as Brydone does. But I cordially agree with his contention that it should be considered a distinct zone—this is the only satisfactory way of dealing with transitional series.

From below the *Conulus*-band to the top of the Yellow Rock at Whitway (see Andover Memoir, p. 30), *Conulus albogalerus* of the characteristic conical shape occurs sporadically but in fair abundance. In the rock itself I recently found two very large specimens of *Echinocorys vulgaris striata*, which is to be collected in the overlying soft chalk as well. Below the rock I have never seen a trace of either of these two Echinoids, although *Micraster* and *Inoceramus* are quite abundant. In all the quarries on the northern side of the ridge-road from Whitway to Kingsclere, the chalk seems to be similar in every respect to that between the

yellow-rock and *Conulus*-band at Whitway. *Conulus albogalerus* is fairly common in them, all (the small globular form being absent) and it often attains a considerable size, recalling the classic examples from Gravesend. In the more westerly of the twin quarries to the east of Ecchinswell, I found recently a very good specimen of *Spondylus spinosus* with both valves preserved, a very rare occurrence at so high a horizon. The discovery was rendered the more striking since a fine example of *Conulus*, and a large *Micraster coranguinum latior*, were in the same block of chalk.

The zone of *M. coranguinum* is of very unwieldy proportions. On the Continent it has been considerably subdivided, but in this country the higher and lower zones, which afford fuller faunas, have received greater attention. It seems reasonable to suggest that, for the south-east of England at any rate, a sub-zone of abundant *Conulus albogalerus* should be recognised at the top of the zone. Wherever, in the Thames Valley or south of it, the higher beds of the zone appear, this easily recognised fossil is recorded. Its discovery is commented upon with surprise and joy, if it has been found in the middle or lower parts of the zone. If so relatively thin a zone as that of *Marsupites* can be subdivided, it seems likely that, granted a sufficient body of fossil-evidence, the two or three hundred feet of *coranguinum*-chalk could be zonally differentiated. Since the upper 30 or 40 feet of the zone are reasonably fossiliferous, and contain a faunal assemblage easily distinguished from that in the rest of the zone, I here propose that they be marked off from the lower parts under the name of "Sub-zone of *Conulus albogalerus*." In addition to the index fossil, *Cidaris clavigera*, *Echinocorys vulgaris striata*, and *Micraster coranguinum latior* are rare beyond the limits of the suggested sub-zone. At Whitway, which may be taken as the typical locality for the sub-zone, its upper limit may be considered to be marked by the first *Uintacrinus*-plate found above the *Conulus*-band, and its lower the base of the yellow rock. This lithological floor to the zone is not, however, certainly extensive over a large area; although in many localities similar rock-bands occur in the *coranguinum* zone, and one of these may prove to be

constant in horizon. Brydone records a yellow rock at Itchen Abbas and Abbot's Worthy which, to judge from his account, is probably a continuation of the Whitway bed.

(e.) THE TERTIARIES.

The Tertiaries are very poorly exposed in the district immediately to the north of the Vale. The only cutting in the Reading Beds that I have seen is in the small and disused Burghclere brick-yard; a little to the east of the Whitway cross-roads. Here brightly mottled clay, similar in all respects to that of the type-locality, is seen in a much degraded face, and there are indications of impersistent layers of "silver-sand" at some points.

Generally speaking, the Reading Beds show a considerable constancy of thickness over the western end of the London Basin, rarely varying beyond the limits of 70 to 80 feet. This is in marked contrast to the steady thinning of the normally more important London Clay as its outcrop is traced westwards. In this connection a brief comment on the interpretation of two well-sections given by Mr. Whitaker in the last number of these proceedings seems necessary. It is rash, and not a little presumptuous, for anyone to disagree with so experienced and well-tried a specialist as Mr. Whitaker. But the present writer knows, from bitter experience in the study of borings in various parts of the country, both wells and coal trials, how maddeningly insufficient and inconsistent the descriptions of the rocks traversed may be. The number of alternative readings of many sections can be limited only by the number of independent readers. Each one is naturally convinced that his interpretation is more probably correct than that of the others, but no one can be dogmatic in cases like these, where the beds passed through are variable and not very dissimilar.

The two wells in question (Proc. Hants. F. Cl., vol. viii, part 1. pp. 48—50) are situated at Beenham Court and Stratton's respectively. In the former Mr. Whitaker takes the top of the Reading Beds at 223 feet down, while the chalk occurs at a depth of 268 feet. This leaves 45 feet only for the thickness of the

Reading Beds, the London Clay being given 193 feet. (The division between London Clay and Reading Beds in this section is admitted to be doubtful.) In the latter case a two-foot bed of "Stone" at 245 feet is queried as being the basement bed of the London Clay, while the chalk comes at 299 feet down. (There is obviously an error in figures in this account:—neither 50 nor 51 added to 299 make 300; presumably this is a misprint for 350.) The Reading Beds are thus allowed 54 feet in this well.

Both of these thicknesses, 45 feet and 54 feet respectively, are out of keeping with the isopachytes of the Reading Beds of this part of the London Basin. I should be inclined to call the 10 feet of "Brown Sand" between 193 and 203 (in the Beenham Court well) the top of the Reading Beds, making the 1 foot of "Green Sand" immediately preceding, the basement of the London Clay. Such a reading would reduce the London Clay to 163 feet (from 193) and swell the Reading Beds to 75 feet. The reading is supported by the published record of a well at "Stanton's," near Kingsclere, where the top part of the Reading Beds consists of 34 feet of sand. On my assumption, this would be represented by 33 feet (described as "Brown Sand," "Light Sandy Clay," and "Brown Sand") at Beenham Court.

In the Stratton's well there are numerous beds of "Stone," and some labelled "Claystone," in the body of the rocks identified by Mr. Whitaker as the London Clay. He chooses the lowest of these beds as being possibly the basement bed. But there are often indurated layers of Sarsen or conglomerate in the Reading Beds. "Coloured Clay" first makes its appearance in the section at a depth of 224ft. 6in., just below one of the "stone" bands. Above that band, for the first time since the passage beds to the Bagshot Sands, the London Clay is described as "Sand and Clay." The mottled quality that is generally described as "Coloured" is never, so far as I know, found in the lower parts of the London Clay, while it is normal throughout the Reading series. If the top "Coloured Clay" be taken as the top of the Reading Beds, the London Clay is reduced from 158 feet to just over 137 feet in thickness, while the Reading Beds are

expanded from 54 feet to 74 feet 6 inches. For convenience of reference the two alternative readings of these two well-sections may be summarized.

(I.) BEENHAM COURT.

	Whitaker, 1917.	Here suggested.
Drift, etc ...	3 feet	3 feet
Bagshot Sands ...	27 feet	27 feet
London Clay ...	193 feet	163 feet
Reading Beds ...	45 feet	75 feet
Chalk ...	102 feet	102 feet

(II.) STRATTON'S.

Old Well...	33 feet	33 feet
?Bagshot Sands ...	54 feet	?54 feet
London Clay ...	158 feet	137 feet 6 inches
Reading Beds ...	54 feet	74 feet 6 inches
Chalk ...	c. 50 feet	c. 50 feet

Whether the upper limit of the London Clay is correctly identified or not in the second case is a question on which I cannot express an opinion.

(III.) THE TECTONIC FEATURES OF THE DISTRICT.

(a.) THE KINGSLERE PERICLINE.

As the mapped outcrop of the Chalk Rock indicates, the pericline produces an inlier of an elliptical shape, with its greatest length (some $6\frac{1}{2}$ miles) extending in an east and west direction. Generally speaking, the inlier has its greatest breadth (about $1\frac{1}{2}$ miles) midway between the two extremities, towards both of which it tapers with some regularity. But at the south-western corner a large (geographically) basin-shaped area, broken in one place by the abrupt outlier of Beacon Hill, stretches for a distance of two miles or more southwards of the "normal" margin of the ellipse.

The structure of the Vale is undoubtedly periclinal, but the dome-curvature is not nearly so important as a study of the outcrops alone would indicate. The rocks of the whole area have a

pronounced pitch in a roughly easterly direction, and the closing in of the Vale at its western end is as much the result of increased elevation of the land surface as of any westerly plunge of the strata. This means that the area is constructed of an asymmetrical or tilted pericline, wherein the eastern margin is rather steep and the opposite one almost horizontal. The chief folding is in a north and south direction, as the shape of the inlier indicates. The southern escarpment is cut across gentle southerly dips (rarely exceeding 5°), while the northern rim is built of the transversely eroded edges of rocks dipping at relatively high angles (between 20° and 30° , and perhaps more locally) to the north. The northerly dip seems to attain its greatest steepness midway along the margin of the Vale, and to steadily decrease in intensity towards Highclere and Kingsclere. This would imply that the complementary syncline (in the London Basin) should attain a considerable depth quite near to the chalk outcrop on the median line, and farther away from it towards the two extremities of the area. Calculation from outcrops and well-sinkings shows this to be the case, although a superficial view of the map, with the Bagshot series occurring to the north-west and north-east, and almost completely absent from the area due north of the Vale, would lead to an opposite conclusion. The anomaly seems to be due solely to the differences in surface contour.

In Plate 2 I have endeavoured to show graphically, by tracing and calculating the levels of the Chalk Rock, the nature of the folding to which the strata have been subjected. (The dark broken line represents the actual outcrop of the Chalk Rock). Whatever errors in the estimates of the existing levels of this horizon may occur, they are constant throughout the area; so that the *character* of the folding will be correctly indicated, even if its amplitude be over or under-estimated. The predominant east to west strike is strongly brought out in this diagram; but save at the eastern end, there is little of the swing-round of the contours that would mark a normal pericline. Moreover, the east and west trend of the levels is by no means straight, but in some places takes on a subsidiary curvature. This is specially noteworthy

PLATE 1.

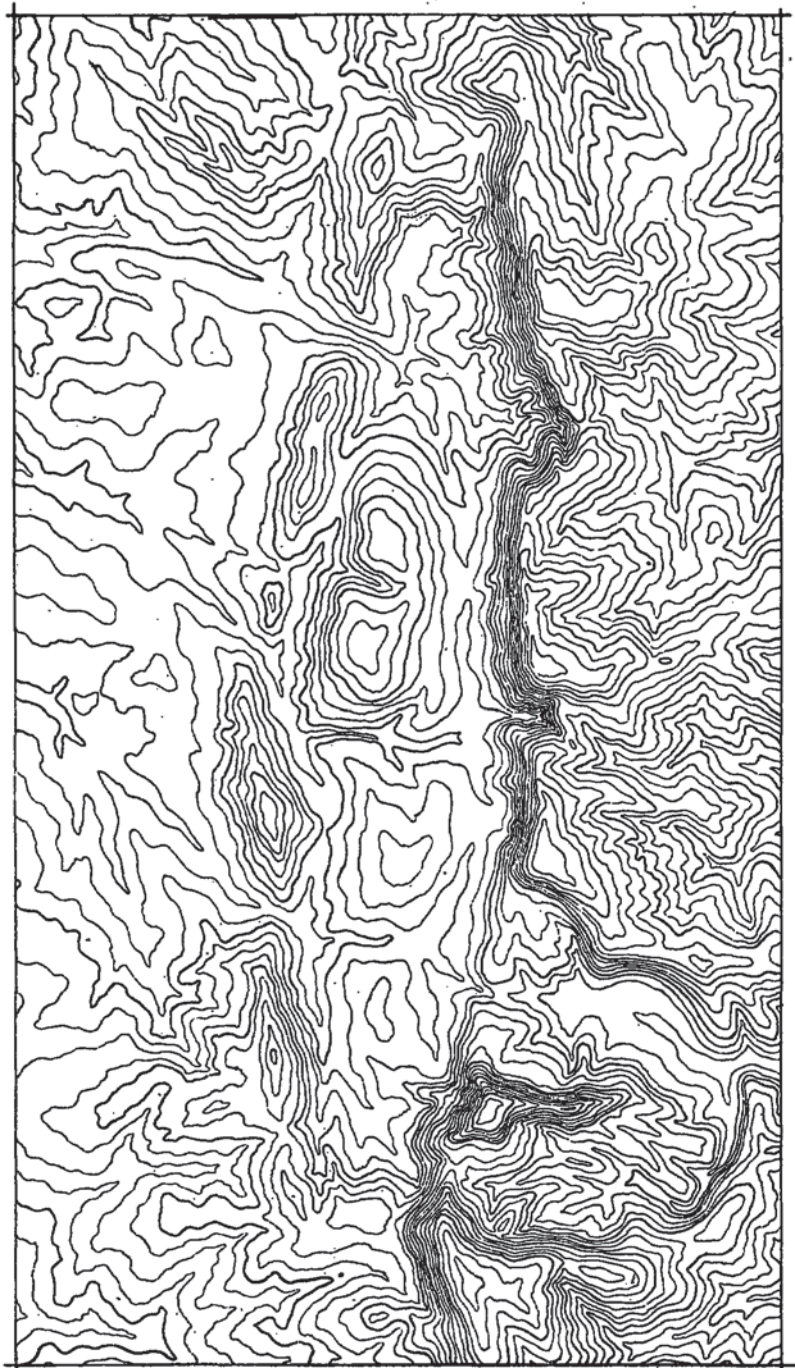


PLATE 2.



midway along the northern slope, and in the area in which Beacon Hill stands. In both of these districts the contours swing outwards from the central axis, indicating extensions of anticlinal folding to the north and south respectively. The great bowl between Burghclere and Litchfield is excavated in a shallow but definite anticlinal area distinct from that which produces Isle Hill. For convenience of reference these two components of the periclinal may be termed the "Beacon Hill" and "Isle Hill" anticlines. They would seem to have a more or less north and south trend, and by their intersection of the main east and west fold are jointly responsible for the compound pericline of the Vale.

In passing, attention may be drawn to the extremely marked contrast between the designs of Plates 1 and 2. The former shows the surface contours, with the steep escarpment on the south of the Vale, and a barely conspicuous ridge of equal-sloped hills on the north. The latter shows the steep dip of the northern limb of the fold, and the relative gentleness of the "return-dip" on the southern limb. The relation between escarpments and the angle of dip could hardly be more clearly expressed.

(b.) THE RELATIONS OF THE KINGSCLERE PERICLINE TO
THE STRUCTURE OF ITS SURROUNDINGS.

In this concluding section of the paper the word "Notes," with which the title begins, becomes peculiarly appropriate. Time and space forbid a discussion of past theories and opinions, and both conspire to exclude many of the arguments and data on which the sequel is based. It is possible here only to indicate the more obvious tectonic features of the district, and briefly to suggest certain tentative deductions from them.

The London Basin is essentially an east and west syncline with an easterly pitch. In the neighbourhood of East London this pitch is temporarily interrupted by the Deptford, Grays and Chatham chalk ridge, but it soon re-asserts itself towards the mouth of the Thames. The dual character of the folding of the rocks gives a resultant strike, the trend of which is roughly north-

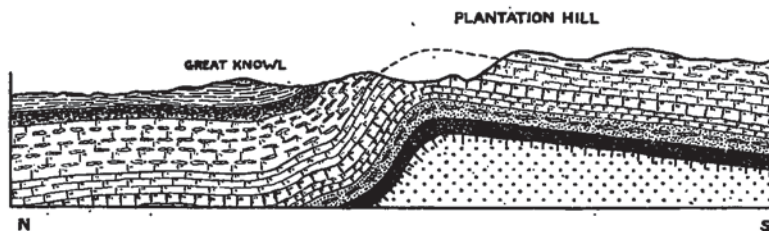
east to south-west along the northern margin of the basin, and more nearly east and west on the southern border. If the degree of inclination of the syncline and that of its pitch were equal, and directed at right angles to one another, the bounding strikes produced should be north-east to south-west and north-west to south-east respectively. These conditions are almost fulfilled in the northern part, but along the southern margin the excess of dip over pitch results in the production of a strike very nearly at right angles to the former, and hardly affected by the latter.

The dip of the southern limb of the syncline is steepest along the Hog's Back, between Guildford and Farnham, and along the northern rim of the Vale of Kingsclere. In both these neighbourhoods the strike becomes locally almost perfectly east and west in its trend. Between them, from Kingsclere to Crondall, an element of the north-west to south-east strike appears, although the east to west character still predominates, for the dip is still stronger than the pitch. (East of Guildford the strike of the southern edge of the basin takes on a partially north-east to south-west trend, due in part to the oncoming of the East London ridge.) In two districts only, along the entire southern border of the London basin, does the "ideal" north-west to south-east resultant strike appear. These are from Chatham to Dover and from Walbury Hill to Highclere.

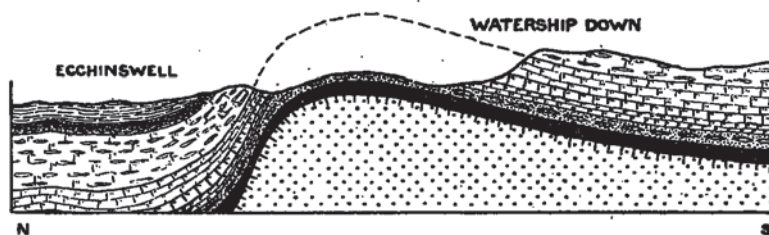
A purely geometrical argument would require that this median resultant should be due to the similarity in degree of the dip and the pitch of the rocks in the two localities specified. In the latter case (with which we are more particularly concerned), field-evidence lends but little support to such a conclusion. Although the *amplitude* of the anticlinal fold which connects the Vales of Kingsclere and Shalbourne is insufficient to expose Selbornian rocks between the two extremes, the actual dip of its northern flank is but little varied and always considerable. It might be argued that, if this be true, the pitch must have locally increased so as to equalise the value of the two intersecting fold-systems. But a reference to the field relations of the rocks fails to reveal any such phenomenon. Study of well-sections which reach the

PLATE 3.

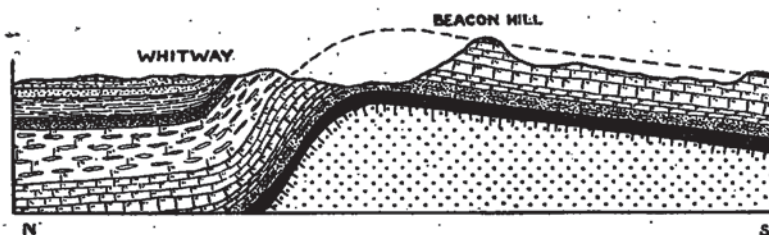
	BRACKLESHAM BEDS.		MIDDLE CHALK.
	LOWER BAGSHOT BEDS.		LOWER CHALK.
	LONDON CLAY.		"UPPER GREENSAND."
	READING BEDS.		"GAULT."
	UPPER CHALK.		OLDER ROCKS.



SECTION $\frac{3}{4}$ MILE E. OF KINGSCLERE.



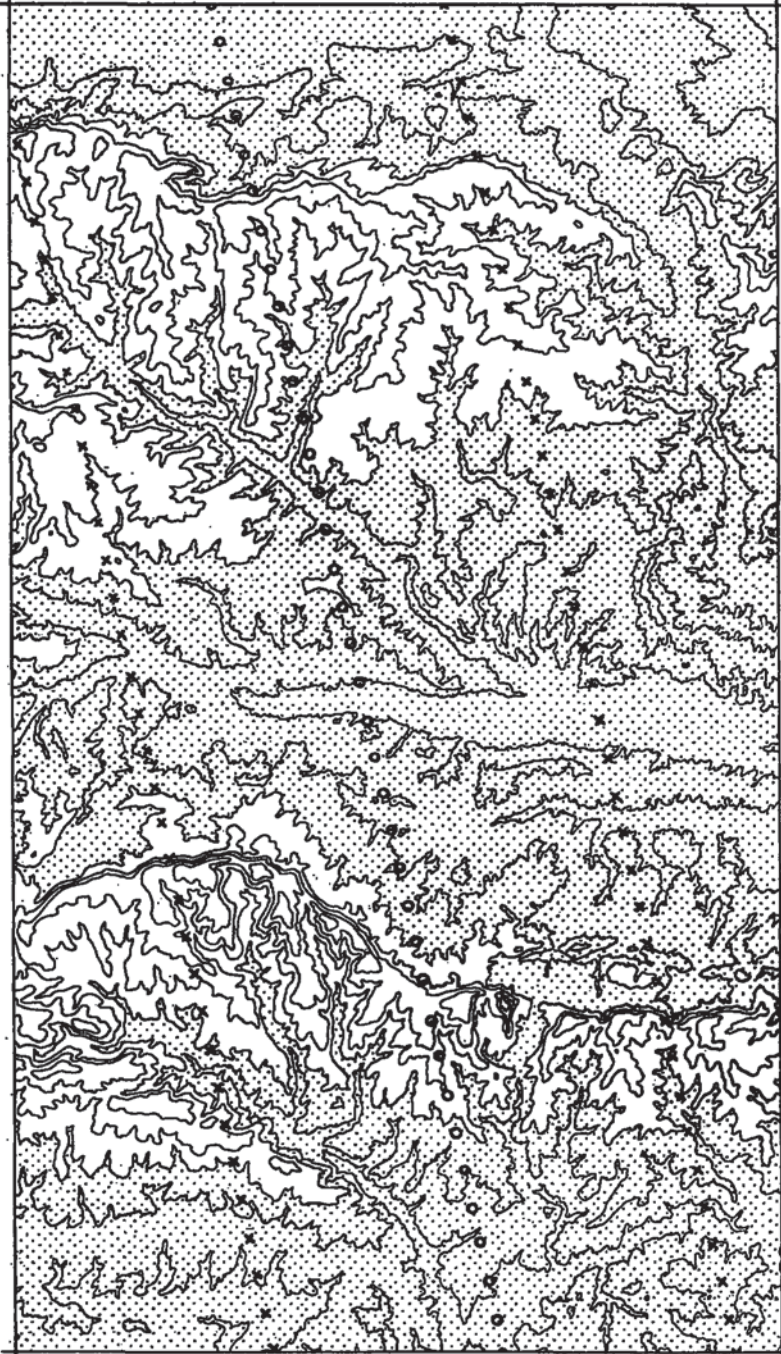
SECTION $1\frac{3}{4}$ MILES W. OF KINGSCLERE.



SECTION 4 MILES W. OF KINGSCLERE.

HORIZONTAL SCALE — 1 INCH TO A MILE.

PLATE 4.



chalk through the tertiaries at the western end of the London Basin gives no suggestion of any rapid increase in the west to east declivity of the surface of contact between the two rock-systems. Clearly some other character must have determined the local production of this strike, which, though one hesitates to apply the term, is approximately "Charnian" in trend.

A reference to the contoured map, Plate 4, will show a very striking analogy between the rock-trend of the southern and northern borders of the London Basin in this region. (The crests of the escarpments of the Berkshire and Hampshire Downs can be roughly considered to be the lines of outcrop of the Chalk-Rock). Inkpen, the great northward salient in the southern ridge, is matched, on a slightly smaller scale, by the White Horse Hill on the northern scarp. The latter is a little to the west of north from the former. Eastward from both of them a "Charnian" trend is developed, which subsequently turns abruptly to take on the east and west strike. In the Berkshire Downs the strike becomes very faintly reversed to the north-east to south-west direction just before swinging round by Churn into a repetition of the north-west to south-east quality, which is there a border to the broad shallow syncline through which the Thames breaches the escarpment at Goring. In the Hampshire Downs, if the northern fringe of the Vale of Kingsclere be chosen (as it should be) instead of the more prominent southern escarpment, a corresponding north-east to south-west direction is assumed by the rocks from Highclere Park to Ecchinswell, and then, beyond, the limits of the map, they sweep southwards and eastwards into the wide and shallow cross-syncline that separates the Kingsclere dome from that of the Weald.

The conclusion seems inevitable that the determinants of the strike in the one case must also be decisive in the other, so that it is necessary to postulate the occurrence of transverse folds crossing the western end of the London Basin in a direction north-north-west to south-south-east. I have indicated the probable course of these presumed fold-systems by broken lines across the map. The two lines marked xxx represent anticlines, and

the intervening one (ooo) a syncline. It must, of course, be realized, that these cross-folds are of very small amplitude—they are almost to be regarded as mere disturbances in the easterly pitch, but a reference to the preceding section will show that such a description is particularly apposite for the cause of the Kingsclere pericline.

Now the regions where the East London ridge (which is more or less of a continuation of the true Charnian axis, through Northampton and Ware) crosses the margin of the London Basin, are modified in almost exactly the same manner as those just considered. In that case the interruptions in the normal strike of the syncline and its surroundings are known to coincide with the presence of Palaeozoic rocks situated at no great depth below the Gault. The Silurian rocks of Ware, the Old Red Sandstone of London, and the Coal Measures of Dover are all associated with this cross-fold. Without drawing any definite conclusions, and with a careful avoidance of all kinds of prophecy or guarantee, it is fair to take leave of the problem in the following terms.

In the Sydmonton gorge, near the middle of the Vale of Kingsclere, there cannot be more than fifty feet of rock to traverse before the Gault would be reached, and probably there are but twenty. It is unlikely that the Gault exceeds 100 feet in thickness—it may be twenty or thirty feet thinner. A sinking or boring of less than 200 feet would therefore show whether the Lower Cretaceous rocks occur or not below the district. And even if they do so occur (and they may well not), there is some reason to believe that the underlying Jurassic rocks may be relatively thin, so that in a thousand feet or a little more it is quite possible that the Palaeozoic rocks may be waiting. These might be Silurian (or older), Devonian or Carboniferous. The chances against their proving to belong to the period last named are not very heavy. Will anyone take the risk?

EXPLANATION OF PLATES.

PLATE 1. (p. 204).

Contoured map of the Vale of Kingsclere. The contour intervals are taken at 25 feet. Scale:—1 inch to a mile.

PLATE 2. (p. 205).

The contours of the Chalk-Rock in the same area as that of Plate 1. Contour intervals and scale the same.

PLATE 3. (p. 208).

Three serial sections across the Vale, showing the development of the steepest fold in the centre of the area, and the steady westerly rise of the whole rock-series. The vertical scale is about four times the horizontal, hence the apparent thinning of the strata where the dip is high.

PLATE 4. (p. 209).

Contoured map of the western end of the London Basin. The White Horse Hill is near the north-west corner, Churn near the north-east corner, and Newbury near the middle; the Hampshire Downs passing in a transverse line across the lower third of the map, with Inkpen on the west and Kingsclere on the east. Scale:— $\frac{1}{4}$ in. to a mile. Contour intervals at 100 feet. All the area below 500 O.D., stippled. For explanation of the crosses and rings see p. 210.