TRANSACTIONS : When Vol. xvii is bound, the Norfolk Bird Report for 1953 should be incorporated as an Appendix. A Title Page and Index to this volume will be issued in due course.

TRANSACTIONS

OF THE

Norfolk and Norwich

NATURALISTS' SOCIETY

EDITED BY A. BUXTON (PARTS I AND II)
E. A. ELLIS (PARTS III—V)

VOL. XVII

1949 – 1953

NORWICH
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1956

LIST OF CONTRIBUTORS

with references to the articles contributed by each.

ILLUSTRATIONS

Plates will be found opposite the pages indicated.

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TRANSACTIONS

OF THE

Norfolk and Norwich

NATURALISTS' SOCIETY

FOR THE YEAR

1949

VOL. XVII PART 1.

EDITED BY MAJOR A. BUXTON

NORWICH

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FEBRUARY, 1950

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TRANSACTIONS

OF THE

Norfolk and Norwich

NATURALISTS' SOCIETY

FOR THE YEAR

1949

VOL. XVII PART I.

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FEBRUARY, 1950

Norfolk and Norwich Naturalists' Society

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NORFOLK AND NORWICH NATURALISTS SOCIETY, 1948–1949.

Income and Expenditure Account for the year ended 31st March, 1949.

1948	Expenditure.	£ s. d.	£ s. d.	1948	Income.	£ s. d.
125	To Cost of Transactions		106 10 0	187	By Subscriptions	187 7 6
	,, General Expenses			5	,, Sale of Publications	3 11 11
49	Postage, Printing and Stationery, ...	37 6 8		192		190 19 5
6	Library Rent	6 5 0		18	,, Interest and Dividends	18 5 6
3	Cost of Lectures	14 16 9				
4	Cost of Excursions	4 15 0				
3	Subscriptions to Scientific Societies...	2 12 6				
—	Research Committee	6 2 6				
—	Entertaining International Geological Congress	7 8 6				
5	Sundries	3 8 0				
			82 14 11			
15	,, Excess of Income over Expenditure for the year		20 0 0			
210			£209 4 11	210		£209 4 11

BALANCE SHEET as at 31st March, 1949.

	Liabilities.	£ s. d.	£ s. d.		Assets.	£ s. d.
732	Amalgamated Funds, 31st March, 1948	746 4 1		64	Subscriptions due	15 0 0
14	*Add* Excess of Income over Expenditure for the year	20 0 0		432	Investments	723 5 5
				297	East Anglian Trustee Savings Bank Account	149 18 0
746			766 4 1	1	Cash in hand	— — —
19	Subscriptions in Advance		26 1 6			
29	Barclays Bank Account		95 17 10			
794			£888 3 5	794		£888 3 5

Audited and found correct

(Signed) C. R. A. HAMMOND,

26th April, 1949.

I

HON. SECRETARY'S REPORT, 1948—49.

Ordinary meetings of the society were held at Norwich Castle Museum on Saturday afternoons during the winter months as follows :

October 9th, 1948 : exhibition of specimens and contribution of notes made by members during the previous summer. Miss R. M. Barnes, Miss G. B. Hilbert, Dr. W. J. McCulley, Capt. R. E. C. Dunbar, Messrs. A. A. J. Foster, J. H. Cook, J. W. A. Lake and J. W. Winter were elected members of the society.

November 6th : Messrs. M. J. Seago, R. P. Bagnall-Oakeley and W. R. F. Addison surveyed the status of some Norfolk birds, indicating changes which had taken place in recent years. Miss Janet Barker was elected a member.

December 4th : Meeting held jointly with the Norfolk Research Committee, when Messrs. E. A. Ellis, J. A. Forsythe, I. Thatcher, A. Buxton, R. E. C. Dunbar, R. R. Clarke and others contributed to a discussion of North Sea tides and their effects on Norfolk rivers. Mr. C. C. Oldfield was elected a member of the society.

January 22nd : notable experiences in bird watching were described by Messrs. A. Buxton, G. F. B. Robinson, H. J. Howard, H. W. Back, S. S. George, J. H. Silverwood, Mrs. Watt, Miss Ferrier, Miss Pennethorne and the Hon. Secretary. The following new members were elected : Mrs. V. Stannard, Messrs. K. C. Durrant, W. E. H. Fiddian and G. Oldfield.

February 26th : the effects of winter on Norfolk wild life were discussed following a brief survey by the Hon. Secretary. Specimens exhibited included skins of whiite-fronted and lesser white-fronted geese, a sample of deal timber excavated by imported ants (*Camponotus herculeanus*) at Cromer in 1948 and larvae of the moth *Limnoecia phragmitella* inhabiting greater reed-mace from Surlingham. The following new members were elected : Miss R. K. G. Vaughan, Messrs. R. E. Flowerdew, A. R. M. Palmer and R. J. Prosser.

March 26th : Dr. Betty Moss gave an extremely interesting account of the brown seaweeds and their uses, illustrating her talk with lantern slides, living seaweeds and a number of seaweed products. Mr. T. H. M. Baker was elected a member of the society.

The 80th Annual Meeting was held at Norwich Castle Museum on April 30th, 1949, when the President, Mr. R. Pearce Gould, F.G.S., delivered an address entitled " Norfolk through the ages, up to the advent of Man." Officers for 1949–50 were elected as follows : President, Mr. James Fisher ; President-elect, Mr. J. E. Sainty ; Hon. Auditor, Mr. H. W. Back ; Hon. Treasurer, Mr. D. A. P. Gould ; Hon. Secretary, Mr. E. A. Ellis, Dr. Joyce M. Lambert, Mr. B. L. Palmer and Mr. M. J. Seago were elected to serve on the Committee for three years. The Hon. Treasurer presented the audited accounts for the year April 1st, 1948 to March 31st, 1949 and these were approved. The following new members were elected : Misses M. Andrews, B. Weston, E. Busfield and V. J. Stevenson, Dr. H. J. S. Morton, Messrs. A. C. Hewitt, C. W. Brown, A. Phillips and T. A. Potts.

II

PRESIDENT'S ADDRESS

NORFOLK THROUGH THE AGES.

Up to the Advent of Man.

Presidential Address delivered by R. Pearce Gould, F.G.S. to the Members of the Norfolk and Norwich Naturalists Society at Castle Museum, Norwich, on April 30th, 1949.

I have chosen the title of this address "Norfolk through the Ages" because I want to try and trace for you the geological story of Norfolk from earliest geological time—the Pre-Cambrian—up to the time of the Advent of Man.[1] I do not claim that I am producing any new theories but rather I am attempting to collate the evidence and work of other geologists and apply it specifically to our home county of Norfolk.

From local recent deposits and going back as far as the Chalk, we have ample evidence to build up our picture, but beyond this we have to rely on the data obtained from a few deep borings—the most important being the one made recently at North Creake. The Chalk takes us back some 140m years only, whereas Pre-Cambrian times date back 2000m years or more. You can understand then that the greater part of the geological history of Norfolk is largely conjecture.

Before discussing the detailed conditions that prevailed during the various stages of geological time, let me say a few words about the way in which the continents as we know them to-day came into existence. Prof. Wegener's theory is that the large land masses of the world do not remain stationary but drift about as lighter blocks on a heavier and deeper material which underlies them, rather as an ice-floe drifts about in the sea. The crust must be especially thin under the oceans. This doctrine is now widely accepted.

1. See Geological Time-Scale page 15.

He contends that in early times there was only one large land mass (Plate 1). Under the influence of deep earth currents this land mass was broken along its weaker lines (Plate 1), and after the Chalk, as time passed, the continents, as we know them to-day, drifted apart. As the continents drifted apart they also drifted in relation to the poles which gives us an explanation of the changing climates of the continents through the ages, as well as an answer to the distribution of similar species of flora and fauna in now widely separated continents.

But let us go back to the beginning of geological time with the earth temperature cooling and the atmosphere at round about 700° F. Imagine a heavy atmosphere full of water vapour condensing into clouds and developing into rain of great intensity. This rain, beating against the ground, would produce cooling and contraction of the land, forming ridges. The first hills and mountains. The rain water would start the process of erosion, and in due course as the water found its own level, seas would be formed. This was long before there was any question of the one large land mass breaking into the different continents ; but I should make it clear that although there was only one land mass that mass was at varying times and varying places depressed, forming shallow seas. Somewhere in the middle of this mass was a small area which we now call Norfolk ; as we shall see, sometimes it was land and sometimes a shallow sea.

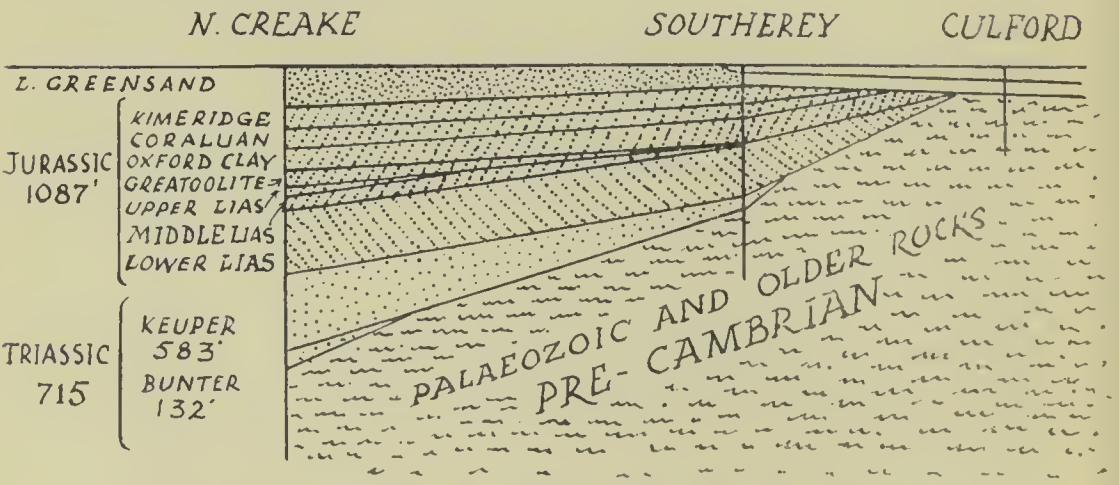


Diagram 1. Showing the relationship of the Mesozoic rocks to the Palæozoic Platform in East Anglia.

In Pre-Cambrian times we have evidence that Norfolk either formed part of a vast plain stretching away into the Midlands or it formed part of a range of mountains as great as the present day Caucasus. As the Cambrian sea spread across the plain it seems that Norfolk was left high and dry as a platform. We know this from an examination of various deep well borings which go down as far as the Pre-Cambrian (Diag. 1). In these borings we find no trace of any Cambrian sedimentary deposits and we can trace with a limited degree of accuracy the shape of the raised platform of Pre-Cambrian Rock. To-day, starting from North Creake, it rises some 2000 ft. in a gentle slope towards Culford in Suffolk and then falls away more sharply to a point at Lowestoft some 850 ft. above that of North Creake.

The metamorphised Pre-Cambrian rocks at North Creake (a Charnian type agglomerate or tuff) one similar to those which can be seen at Windmill Hill Quarry, near Nuneaton. There, great boulders of Pre-Cambrian rocks were torn from sea cliffs and incorporated in beach deposits of the Cambrian Sea.

During the following Ordovician and Silurian times Norfolk continued to be a land mass rising out of the sea. They were warmer times when the first fishes appeared and, in the Silurian, the first Corals. On land the first simple plants appeared in the Silurian and we can imagine Norfolk as a rugged mountainous country with a river system developing and the landscape gradually being eroded away. Perhaps here and there we could have expected to find some patches of elementary plant life. This is as far as Norfolk had developed up to a time 360m years ago.

At the close of the Silurian the beds became more sandy, which showed that a period of elevation had set in—the 2nd Continental Phase. In general, mountain building and regional up-lift came as a logical sequence to a period of prolonged sedimentation in a slowly subsiding geosynclinal basin. The rocks became depressed into a region of higher temperature. The rise in temperature affected all the region of the crust down to an undetermined depth and there was in consequence a very great expansion in volume. In the shallower levels of the


WESTPHALIAN
CARBONIFEROUS
N. ATLANTIC CONTINENT
SCOTTISH DELTA
PENNINE DELTA
WALES-BRABANT ISLAND
S. WALES DELTA
DELTA
CULM FACIES
FLYCH
ARMORICAN MOUNTAINS

Diagram 2.

crust, expansion could only take effect in an upward direction. Powerful lateral pressure was also set up, and this gave rise to the Caledonian mountain building which extended as far as Norway. It was during this 2nd Continental Phase that the first forests would have appeared in Norfolk although we have no direct evidence of this.

In early Carboniferous times the sea again encroached but at the same time a new earth movement was in progress. This movement consisted of earth waves which finally expended themselves against the Wales-Brabant Massif of which Norfolk was now forming a part. (Diag. 2). These earth movements were those which formed the Armorican Mountains to the South and it can be seen that the old rocks of which Norfolk formed a part played an important role in determining the topography of Northern France at this time. Perhaps of more importance were the deltas formed in the later stages of this earth movement. It was in these deltas that the coal basins were laid down which gave rise to all the present-day coalfields of this country and also those of Namur in Belgium. It is probable that during this time the climate was tropical or sub-tropical and for the first time reptiles and insects appeared. It is thought that the areas around the deltas where the coal basins were laid down were swampy morasses, but we have no evidence that those conditions existed in Norfolk, indeed, it is extremely unlikely.

These earth movements of the Carboniferous began what is known as the third Continental Phase and continued through the following periods—the Permian and the Triassic. It was during the Triassic that we have the first evidence that part of Norfolk was submerged (Diag. 1). At the North Creake boring the Bunter Sandstone of the Triassic was found to be 132 ft. in depth resting directly on the Palaeozoic floor. Detailed examination of this sandstone shows that it was deposited in fresh water but that at the time of deposit the area was subject to droughts and flooding. We may deduce that the climate at this time was very arid. It is only to the north of Norfolk that we find this deposit and the remaining part of the county was still high ground.

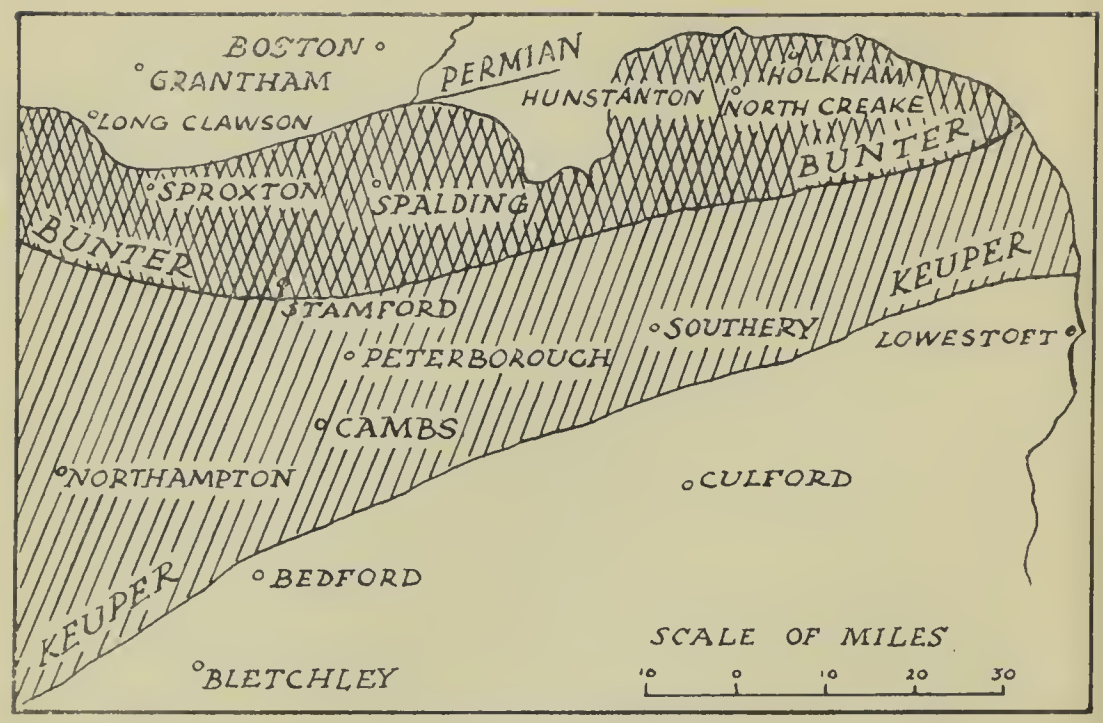


Diagram 3.

The following part of the Triassic produced the Keuper Marls. How these were formed exactly is a problem. The nearest approach to Keuper Marls to-day is in W. Australia where a red lateritic soil has been washed down by heavy rains into a neighbouring plain which first became a layer of sticky mud and then dried out into a marl resembling the Keuper. (Diag. 3). In Norfolk the Keuper Marls at North Creake are 583 ft. thick and then peter out to the south of Southerey. In general we may say that the Keuper consisted of periods of great dryness interspersed with others of a more humid climate.

During the Permian, many land and sea reptiles were evolved and by the end of the Triassic the first mammals had appeared. The vegetation during both these periods was principally Conifers and Cycads.

At the close of the Triassic (Rhaetic) a barrier somewhere in the South was finally submerged and the sea entered the whole of the English Lowlands and extended to the North of Scotland. With it came an abundant marine fauna from the South and a complete change of sedimentation; black shales, grey or green clays and limestones. The 14 ft. at North Creake lack the typical bedding being a dull brown

and dark grey shale without calcareous bands and is not finely laminated. This bed is difficult to interpret as it is also quite unlike the Lower Lias which follows.

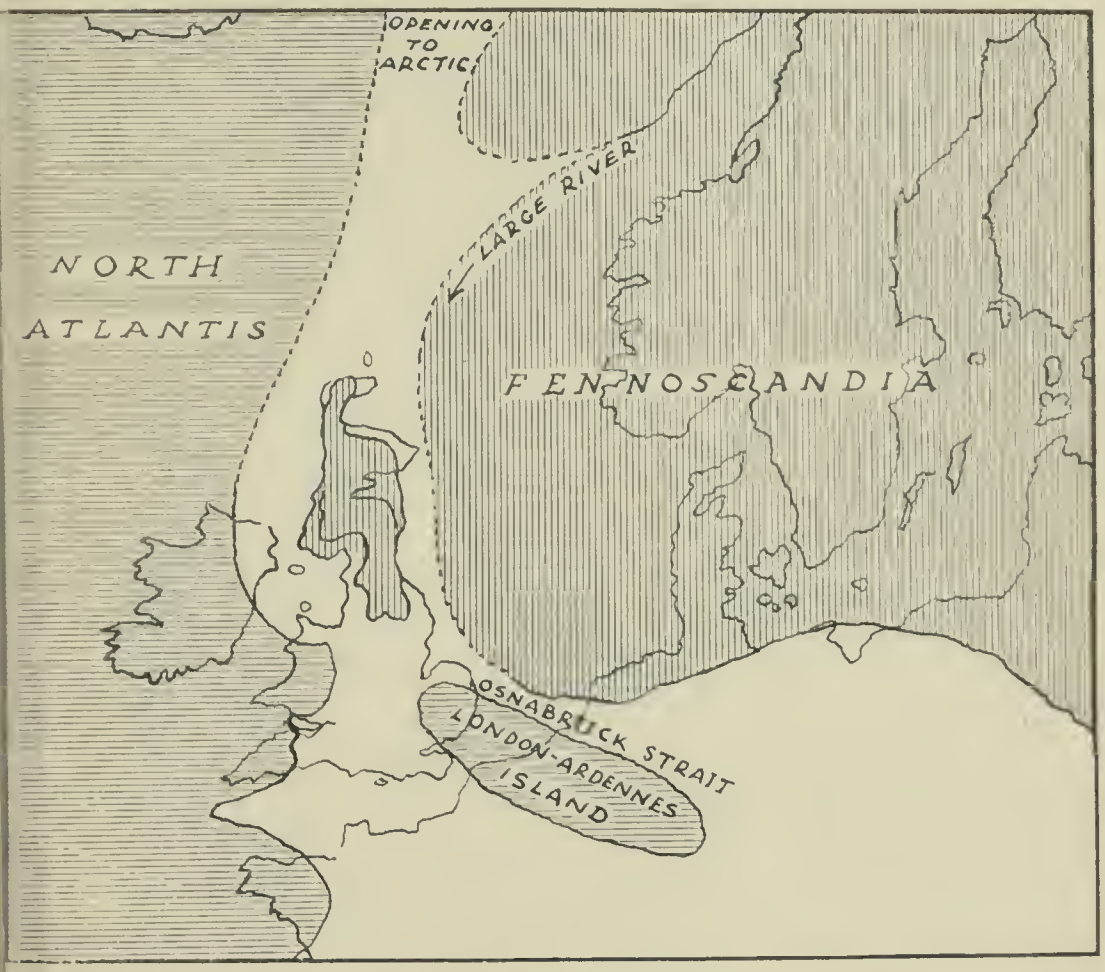


DIAGRAM 4. JURASSICA.

The Jurassic followed the Triassic and during the Jurassic, (Diag. 4) the greater part of Gt. Britain was under the sea, forming a strait between two great land masses. On the one hand a mass covering Scandinavia and on the other a mass covering Atlantis and Ireland. Two islands stood out in this strait—the northern one covered most of Scotland and extended down to the Pennines, while the southern one stretched from Norfolk to the present-day Ardennes. The northern shore of this island ran through Norfolk at times including practically the whole of Norfolk in the island and at others including very little. At the boring at North Creake in the north we have an almost complete series of the

Jurassic beds lying conformably on one another for 1087 ft. (Diag. 1). At Southerey the beds have thinned out and at Culford further to the south thay have disappeared altogether. During this period certain tilting and uplifting of the county was taking place (Diag. 5). We know comparatively little of the climate of this time; the sea was probably warmer than it is to-day as we find in the upper Jurassic an abundance of corals which are only found to-day in waters, the temperature of which never falls below 68°F. The vegetation too suggests a more tropical climate with its luxuriant fern growth. Among the animals there were, for the first time, toothed birds, great slow moving dinosaurs, and many reptiles living in the sea.

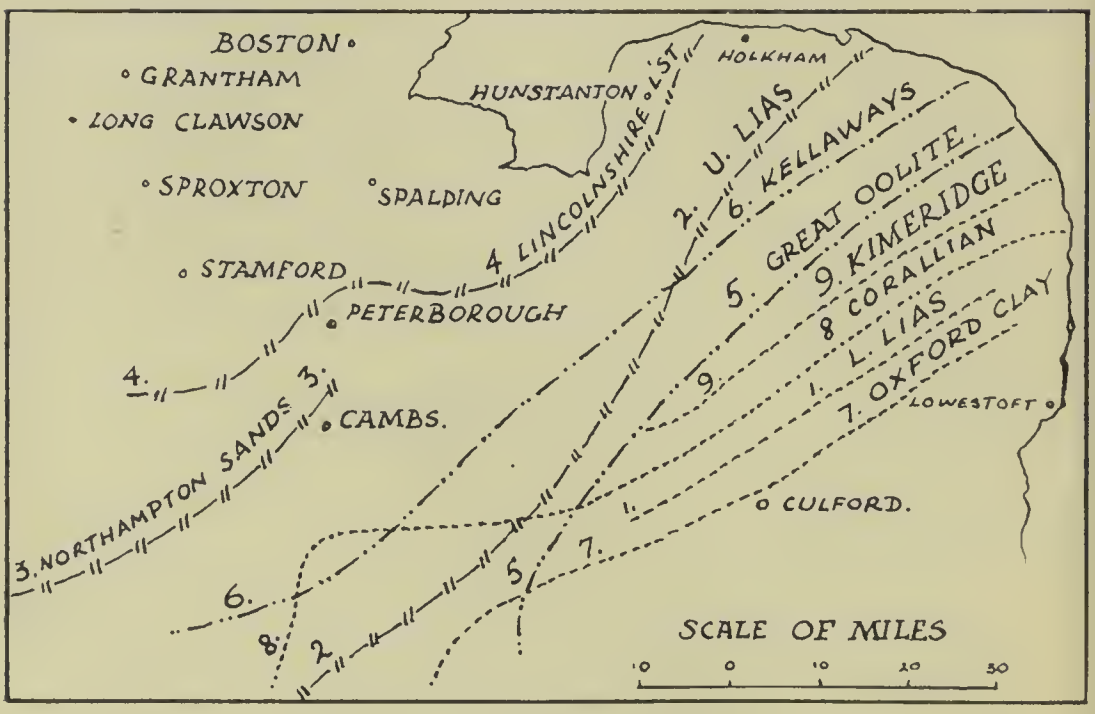


Diagram 5. Jurassic Beds.

Then came the Cretaceous. The uplift of the country that had been taking place during the later Jurassic now gave place to sinking, and the new Cretaceous sea swept across the denuded plains of southern England. The sea advanced by stages. One sea came in from the north-east and another from the south and the two joined up in the Lower Greensand period. Norfolk was enveloped by the sea from the north east. The lower Greensand comes to the surface in West Norfolk in a north-south line running from Downham Market to Hunstan-

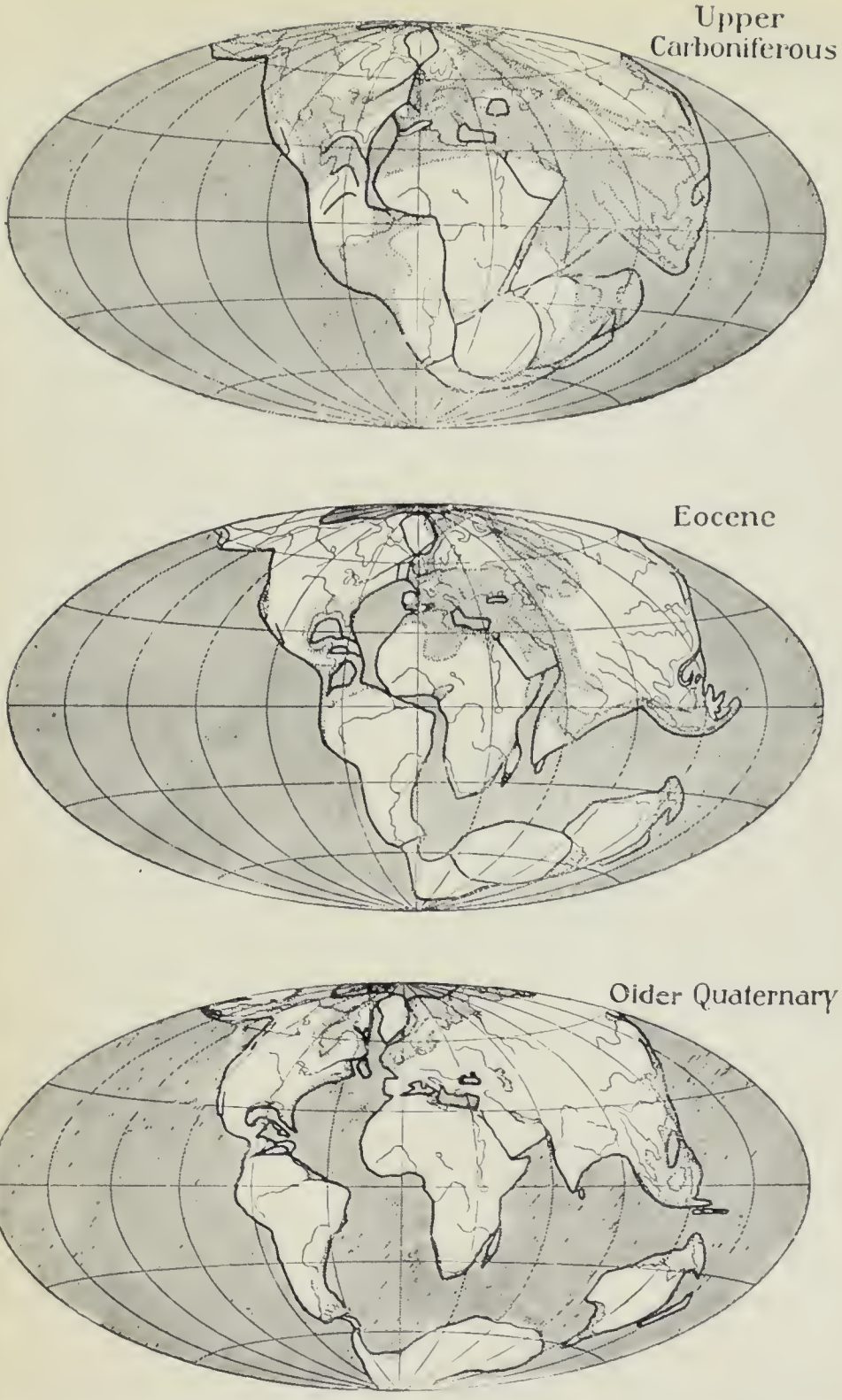
ton. It consists of the Sandringham Sands, the Snettisham Clays and the Carstone. An examination of the Sandringham Sands suggests that they were laid down under estuarine conditions. The other two beds of the lower Greensand were deposited in shallow water but at the end of the period an extensive subsidence brought about a complete change and during the following period a clay formation was deposited—the Gault. The sea in which the Gault was laid down extended further than that of the Lower Greensand in some parts of the country. In Norfolk the Gault is represented by the Hunstanton Red Rock or Red Chalk which overlies the Carstone. It is a condensed deposit for although it is only about 4 ft. in thickness it includes both the upper and lower Gaults. Its red colour is probably derived from red mud washed from lateritic material.

Now comes an abrupt change as we pass from the Red Rock of the Gault to the Chalk. This followed the gradual sinking of the sea floor that had been continuing intermittently for a long period. The subsidence covered an area stretching from Northern Ireland and the western Islands of Scotland across England and North and Central Europe, Poland and South Russia to the Caucasus. Everywhere in this vast area, the predominant deposit for some hundreds of feet (in Norfolk in places 1400 ft.) was chalk. Probably only the highest mountains of Scotland remained above the sea. The formation of the Chalk is remarkable and presents us with two problems. The first, since 98% of Chalk consists of pure Calcium Carbonate what was the source of the Calcium Carbonate, the cause of its deposition and the reason for its purity? Secondly, what was the depth and nature of the sea in which it was formed? First we must account for the vast quantity of fine crystalline Calcite which forms the main bulk of nearly all chalk; if this were not present the formation would ressemble ordinary Limestone. It can hardly be the disintegrated skeletons of invertebrates because it is difficult to conceive where such vast swarms of animals could have lived and then what agency could have ground them up so completely. The best explanation seems to be that it is a chemical or biochemical precipitate resulting from abnormal physical conditions both geographic and climatic. The marine mollusca and echinoderms of the

chalk suggests a warm or even tropical climate and it seems probable that the land surrounding the sea was desert. The well rounded small grains of extraneous matter are suggestive of desert dust blown by the wind into the sea. High temperatures and desert shores would also account for the purity of the Chalk. If there was little precipitation but much evaporation in the sea the concentration of calcium carbonate would in time reach saturation point. Then, with more calcium carbonate brought in by cooler currents a rise in temperature would precipitate calcium carbonate. This theory suggests that the chalk sea was a land locked sea of no great depth ; the evidence of fossils determines the average depth as not more than 600 ft.

Temporary shallowing of the sea took place at times ; we know this, as certain beds such as the Chalk Rock show evidence of current action and include distinctive shells. In Norfolk chalk was deposited over the whole county but subsequent tilting and denudation of the beds has meant that the chalk outcrops appear to the west of a line running north and south through Norwich. The lower chalk is found on the west side of the county being 125 ft. thick at Stoke Ferry near Downham Market and reducing to 56 ft. thick at Hunstanton to the North. Moving eastwards we pass through a belt of outcrops of middle chalk about 200 ft. in thickness and then come to the upper chalk. In Norfolk the upper chalk is thicker than in any other part of the country and in places is over 1000 ft. thick. It includes the Norwich chalk with its familiar cylindrical flint formations 1 to 2 ft. in diameter, Paramoudras. East of Norwich the upper chalk is covered by later deposits, but at Trimmingham on the coast there is an outcrop of the highest zone of the upper chalk and is the only place in England where this zone is found. With the end of chalk times we pass from the Secondary to the Tertiary and it was then that according to the Wegener theory the one large land mass began to break up into the continents of to-day (Plate 1). This was coupled with considerable earth movements and folding which gave birth to the Alps and the Himalayas. The Eocene came first in the Tertiary and in England we find that the long period of steady subsidence that had taken place during the chalk, was

PLATE 1.



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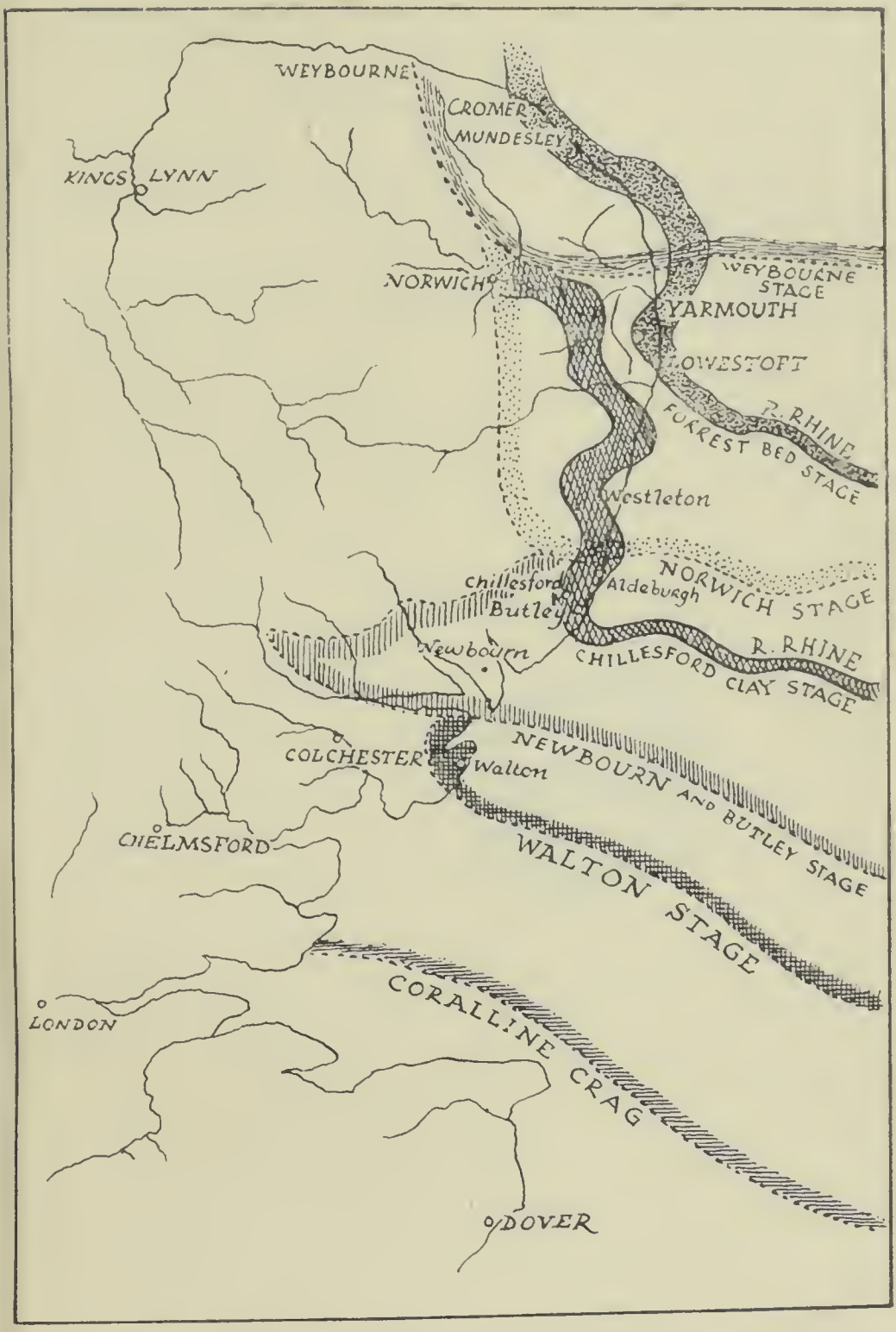


DIAGRAM 6. Showing the estuary of the Rhine and coast line of the Pliocene and early Pleistocene.

followed by the raising of a land mass that covered the greater part of England. The chalk was denuded, tilted and folded. Eventually the south eastern part of the country was invaded by a sea which laid down the earliest Eocene beds. This sea enveloped the whole of Norfolk. As can be imagined the changing geography was accompanied by change in climate, flora and fauna. The hot deserts of the chalk gave place to warm temperate forest conditions. There was heavy rainfall and thicker vegetation developed. Modern genera of plants now appear. Of the animals the great reptiles like the Ichthyosaurs and Dinosaurs have disappeared but several genera of birds and some placental mammals are found.

It was at this time that the flints of the chalk were formed. The process was technical but was due basically to the percolation of water charged with ionised carbonic acid leading to the replacement of chalk by silica, particle by particle. In some places two generations of flints can be found, the second being formed in the later Miocene period.

The Oligocene which followed the Eocene was not an important period from our point of view. Norfolk was raised above the sea and roughly speaking that area of England that was under the Eocene sea became land. In many ways the period was a continuation of the Eocene. More mammals are now found including the first Monkeys and Apes.

The Miocene followed the Oligocene and although the whole of England during this period was a land mass and we find no deposits, the period was one of great importance. Gigantic earth movements took place and it was now that the principal folding of the Alps occurred. The greater part of Europe was land and the North Sea began to take shape. Arms of the Sea were cut off and became salt lakes which in their turn gradually became converted into freshwater lagoons. In the South of England the Oligocene beds of the Isle of Wight and the Dorset coast were folded. In Norfolk we can imagine the denudation of the Eocene and the chalk beds continuing. The fauna and flora were gradually becoming more like that of the present time.

The Pliocene period (Diag. 6) brings us to the end of our story. It is believed that man first appeared in the Pliocene. At the beginning of the period there was a submergence of

GEOLOGICAL TIME-SCALE.

Character	Age in millions of years	Epoch		Time-range of life-groups
	1	Quaternary		Land Plants; Seaweeds & Invertebrates Animals; Fishes; Amphibia; Reptiles; Birds; Mammals; Man
	15	Pliocane	TERTIARY	
4th Continental	35	Miocene		
	45	Oligocene		
(Alpine)	75	Eocene		
3rd Marine	140	Cretaceous	MESOZOIC	
	170	Juraasic		
3rd Continental (Armorian-Pennine)	195	Triassic		
	220	Permian	PALAEOZOIC	
	275 U L	Carboniferous		
2nd Marine				
2nd Continental	320	Devonian		
	350	Silurian		
1st Marine	420	Ordovician		
	520	Cambrian		
1st Continental	2000	Pre-Cambrian	ARCHEAN	
Unknown				

eastern England and Norfolk to a large extent went under the sea. By now it was the North Sea, shallow as it is to-day and opening out to the Arctic. It was fed by the Rhine to the South. Sand, gravel and shells were deposited along the shore or in sand banks under the sea and these deposits form the Crags as we know them to-day. As time passed Norfolk began to emerge from the sea and the shore-line moved northwards. For a time Norfolk formed the Delta of the Rhine. As far as we can tell the climate was much the same as it is to-day, with modern species of both fauna and flora present.

Briefly summarised the following conclusions may be drawn :

(1) The Climates of the land masses of the world have varied considerably as the land masses have drifted in relation to the poles (Plate 2). In Norfolk up to the Advent of Man the climate varisd from equatorial to temperate but was never arctic.

(2) The old Pre-Cambrian rocks underlying Norfolk of to-day formed part of a large mountain range rising to 7,000 ft. in early times. This is of importance to us now as it was these mountains that determined the position of the Coal basins of this Country.

I desire to acknowledge permission to use illustrations appearing in the Geological Magazine and in the works of Professor L. J. Wills.

Some of the Works Consulted.

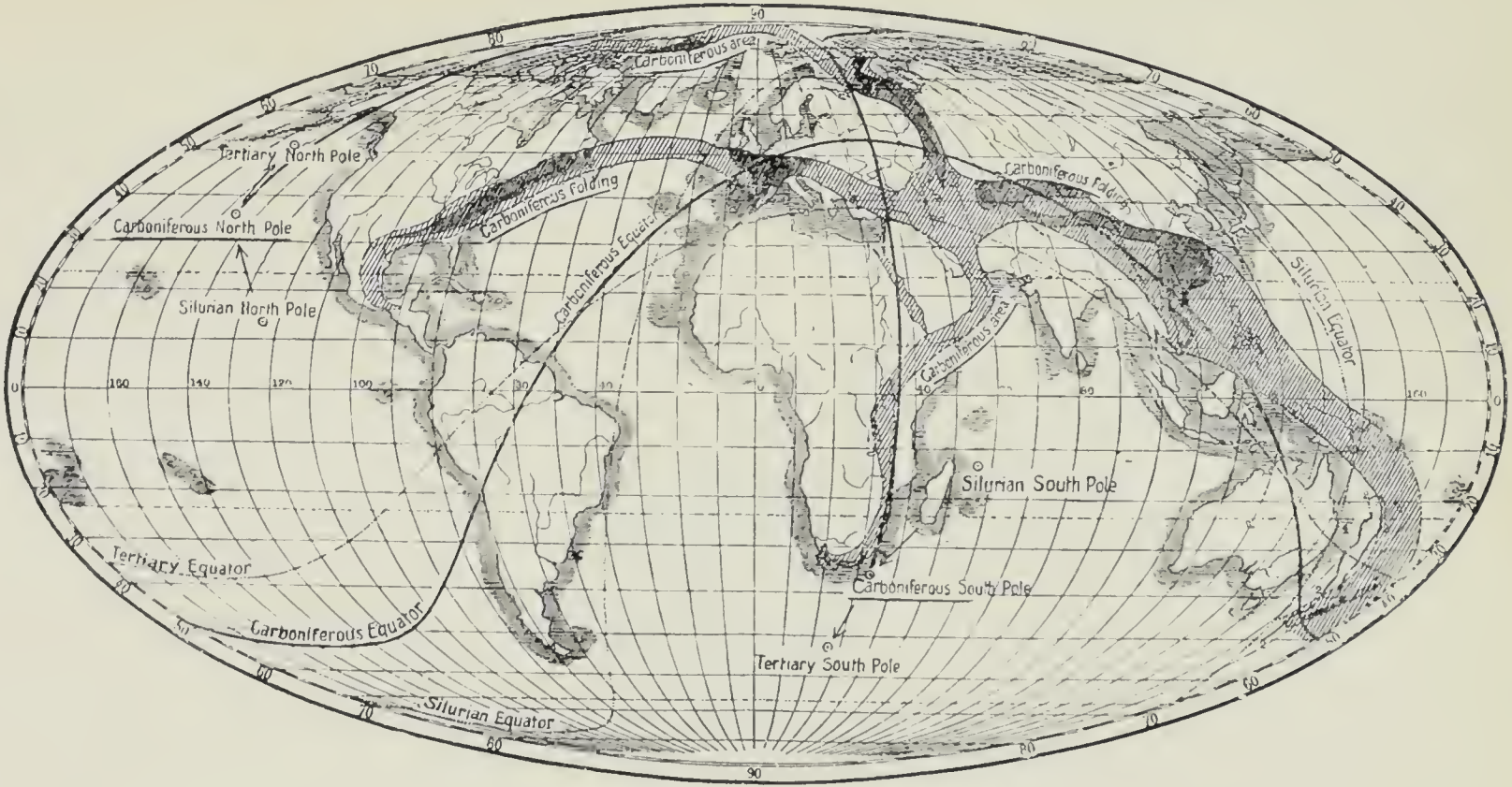
Strahan, Sir Aubrey : Geological Society Presidential Address 1913. Palaeozoic Platform under South Eastern Counties. Q.J.G.S. Vol. IXIX.

Rastall, R. M.: 1927 Geo. Mag. Vol. IXIV p. 15.

Pringle, J.: On the concealed Mesozoic Rocks of S.W. Norfolk Sum. of Prog. Geol. Surv. 1922, p. 26.

Marr and Shipley's Handbook to the Natural History of Cambridgeshire.

Wegener : Origins of Continents & Oceans translated by Skert 1924. Methuen.



Map of World showing climatic changes.

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Flint, R. F.: Glacial Geology of the Pleistocene Epoch.

Arkell: Jurassic System in Great Britain.

Arkell: Geology of Oxford.

Arkell: Analysis of Mesozoic & Canozoic Folding in England. Report XVI International Geological Congress 1933.

Jules Brown: Building of the British Isles.

Wills, L. J.: The Paleogeography of the Midlands, 1948.

Kent, P. E.: A Deep Boring at North Creake, Norfolk, Geological Mag. Vol. LXXXIV, p. 2.

Strahan, Sir Aubrey: Boring at the East Anglian Ice Co. Works, Lowestoft. Memories of the Geological Survey, 1912, p. 87.

Chatwin, C. P., British Regional Geology—East Anglia and adjoining areas (2nd. editions).

III

WILD BIRD PROTECTION IN NORFOLK IN 1949

Report of the Council of the Norfolk Naturalists Trust.

The Council of the Trust has much pleasure in presenting to members its annual report on Bird Protection in Norfolk, together with the ornithological news of the County for 1949.

Two mild winters in succession have done much to help the recovery of the species decimated in 1947, and the number of green woodpeckers, wrens, long-tailed tits, song-thrushes and kingfishers would seem to be normal again. Bearded tits also had another successful breeding season at Hickling, and they have recently spread to Horsey again for the first time since the winter of 1946-7.

An important addition to the Trust's reserve at Cley is the establishment of a bird observatory on the north-west boundary. A bird-ringing trap of the Heligoland type has been built using a wall of the coastal defence works to give it protection from the north. The area around the trap, and the strip of land leading up to it from the Beach road, will be planted with suitable bushes to give covert for small migrants. A room in an adjoining building has been furnished and equipped for the use of the Warden and other observers.

The small committee of management includes Mr. B. B. Riviere, Treasurer of the Trust, Mrs. R. N. Meklejohn and Miss Judith Ferrier both of whom live in the neighbourhood, and Mr. A. B. Alexander who has consented to help the scheme with advice from his wide experience.

Mr. R. A. Richardson, the artist, has offered his services as Warden while he is living in Cley, and he has already done much useful work. He has also compiled the miscellaneous records included in this report.

The Council tender its thanks to him for this valuable help ; also to Mr. R. P. Bagnall-Oakeley for again lending his beautiful photographs for the report's illustrations ; and to all members who continue so generously to subscribe to the Trust's funds.

The following notes are compiled from the diaries kept by the two Wardens of the National Trust reserves at Scolt Head and Blakeney Point (the expenses of both places being shared by our Norfolk Naturalists Trust) and the keepers of the Cley marshes and Hickling Broad.

Major Buxton has kindly contributed his usual notes on the bird life of Horsey, and Mr. Riviere an interesting account of a pair of spotted flycatchers which nested in his garden at Salhouse.

All other notes sent in by various observers are included in the miscellaneous records at the end of the report.

SCOLT HEAD ISLAND.

Records for the year from the diary of Mr. C. Chestney, the Warden.

The winter, a comparatively mild one, was shortened by a spell of unusually warm spring-like weather during February. Colder conditions set in at the end of that month with high northerly winds which reached gale force in the early hours of March 1st. Much damage was done all along the coast and the sea sweeping over the lower parts of Scolt Head Island eroded the dune areas and flattened the shingle ridges. The summer was hot and very dry, and it proved to be an excellent breeding season.

The following birds were among those recorded for the winter months :—

Brent Goose.—There were very few at the beginning of the year and although there was an increase in February at no time was the number as large as usual, nor did they stay as long. The first arrivals in the autumn were seen on October 25th.

Grey Lag-Goose.—A winged bird in very poor condition was caught by Chestney's dog on January 29th.

Pink-Footed Goose.—A skein flew in from the sea on January 27th going towards the south-east. There were comparatively few in the district this winter.

White-fronted Goose.—A skein of nineteen came in from the north on January 1st.

Snow Goose.—A ringed bird was found feeding with some tame grey geese on the marshes on October 3rd and although it was a full-winged bird it remained with them for some time.

Goldeneye.—A few in the harbour on January 25th and during February.

Long-tailed Duck.—Four in the harbour on January 25th, one of them an adult male. Two more were seen on April 18th, and on May 25th a pair, the male of which was in splendid breeding plumage. These birds were very tame and allowed a boat to approach within a few yards.

Velvet Scoter.—One seen on January 7th flying offshore with a party of common scoters.

Woodcock.—Six flushed from long grass on February 3rd.

Glaucous Gull.—On January 3rd one was seen resting on the shore among a group of great black-backed gulls.

Little Auk.—Two were flying along the shore with a flock of sanderlings on January 1st, the first seen alive by Chestney for some years.

Great Northern Diver.—One in the harbour on January 4th was seen again on the 6th and, judging by its behaviour, was trying to rid itself of oil. Another was noted on January 25th.

Black-throated Diver.—Two were in Norton Creek on April 13th, one of them slightly oiled.

Water-Rail.—Two were flushed from the Suaeda bushes at the Overy end of the island on January 29th.

Wood-pigeon.—An immigration was noted on February 12th when one party was judged to consist of 500 birds. The first large influx of the autumn took place on November 7th and went on during most of the day. This was associated with the arrival of hundreds of fieldfares, redwings, green plovers and grey crows.

Greenfinch.—A large number were seen on the beach feeding along the tide-line.

Snow-bunting.—The winter flocks were not so large as usual, nor were there as many " white " birds among them. Some were seen during almost every visit to the Island from January

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Common Terns feeding on Herring Fry.

until April. The first autumn arrivals noted was a party of three seen to come in from the sea on September 19th.

Shore-lark.—Five birds were feeding on the Far Point on January 5th and fourteen on the 28th of the month. The largest party consisted of twenty-four birds seen on April 1st, a late date for the mild season. The first birds of the autumn, nine in number, arrived on October 24th.

Green Woodpecker.—On February 1st four were seen feeding on the Overy marshes, a sign of the recovery of this species which suffered so badly in the winter of 1947.

Kingfisher.—Two were fishing from the sluice by the sea wall on April 19th, the first seen in this favourite spot for a long time. Another was resting on the gunwale of a boat moored in the harbour on August 17th.

Short-eared Owl.—Eleven flushed from long grass on February 3rd and single birds were frequently seen during the winter, hunting over the island. Several pairs remained to breed in the district.

Hen-harrier.—On January 3rd two flying together did not appear to see the Warden until within ten yards of them when they suddenly swerved away. Two more on January 31st were watched sparring along the whole length of the island one apparently trying to drive the other away.

Merlin.—These frequented the island during the winter and were also seen from time to time during the summer months. Two flew close by the Hut at noon on January 3rd.

Breeding Species.

The breeding season was one of the best remembered by Mr. Chestney in his long experience as Warden of the island.

Sandwich Tern.—The first were seen flying along the shore on April 4th, but they did not stay on the island until the end of the month. The first eggs were laid on May 8th. The birds gradually increased in number and nested in nine separate colonies, some on the dunes and some on the shingle ridges. New arrivals in late June may have been washed out from the Scroby Sands, and when some of the earliest clutches were hatching on June 25th twenty-five new nests were counted. A total of 474 pairs was counted and the majority of the young were reared.

Common Tern.—The first arrived on April 13th and the first eggs were laid on May 14th. A total of 974 nests was counted, but with the outlying ones it was estimated that over a thousand pairs bred on the island. Food was short at the beginning of the season, but later there was a good supply of whitebait inshore. The number of young which flew was judged to be three-quarters of those hatched, a good proportion.

Little Tern.—The first were seen on the shore on April 14th. The first eggs were laid on May 14th. Nests were most numerous on the beach by the ternery where 104 were counted, but they spread down the shore as far as Smugglers Gap where there were twenty-three. The majority of chicks flew

Arctic Tern.—Four pairs were identified and were successful in rearing young.

Ringed Plover.—These began making scrapes during the warm weather in February. They started nest-making in earnest early in April and the first eggs were found on the 7th. Fifty-two nests were counted but there were probably more distributed over the wide area of the island.

Redshank.—The only nests looked for were near the ternery where eleven were found. About the usual number of pairs was estimated.

Oyster-Catcher.—Eighty-one nests were counted on the island, and there were others on the " Nod " and the shore by the golf-links. A few early broods were lost in a high tide but the majority of chicks, the first of which were seen on May 25th, survived.

Black-headed Gull.—There was a marked increase in the number of breeding birds this summer. As usual the early nests on the marshes were submerged during spring tides, but when this had happened twice the birds moved up on to the shingle ridges in the central part of the island. For the most part they did no harm, but one or two marauders were seen to raid the ternery swooping down to peck the eggs in unprotected nests.

Sheld-duck.—These also began prospecting for nesting holes in February but did not occupy them until the end of March. Rather more than 200 pairs were estimated and judging by the number of broods in the creek in June they had a successful season.

Mallard.—Six nests were found but from the number of pairs seen there were more breeding on or near the island. One late nest with nine eggs was found in House Hills on June 27th.

Blackbird.—A pair reared two broods in the blackberry bushes behind the Hut. Until recently it was a rare bird on Scolt Head during the summer.

Short-eared Owl.—One pair bred at the Overy end of the island, and there were others in the neighbourhood. From time to time they raided the ternery for young birds; one was seen to take a ringed plover on June 10th, and in the late evening of the 20th another swooped down on two common tern chicks and flew off again with one in each talon. Again on July 1st a short-eared owl was flushed from the ternery and pellets were found there which contained the legs and head of young terns.

A final note for the breeding season was on the evening of August 2nd when terns of all kinds were diving for the white-bait left by the tide in the shallows, a very lovely sight against the setting sun.

At the end of July the first skuas arrived to prey on the terns, and five Arctics on the 28th were chasing them most of the day. On August 23rd a great skua was watched trying to take food from the gannets fishing offshore.

A bittern was disturbed from a pool near the sea-wall in the late evening of August 26th, probably a bird from Burnham Overy, where a pair has bred in recent years.

The autumn movement of small birds was first noted on August 18th and reached its peak in the third week of September. Among those noted were pied and spotted flycatchers, common and black redstarts, wheatears, warblers of all kinds including a nightingale, robins, blackbirds, thrushes, golden-crested wrens, a fire crest and a bluethroat.

On September 21st Chestney heard what he thought to be a very late cuckoo in poor voice calling from the House Hill dunes, but he did not see the bird. On the 23rd when walking round there with a visitor they saw a hoopoe, almost certainly the bird which was heard two days previously.

A dotterel was seen on September 23rd and another on October 1st.

Winter migrants began to arrive in force on October 6th when redwings and fieldfares were flying in from the sea throughout the day. The first grey crows arrived on the 15th with short-eared owls and woodcock. On the 24th a large party of snow-buntings arrived with a few shorelarks and numbers of blackbirds, among them two ring-ouzels. In November large immigrations were seen on six occasions between the 5th and the 20th, and hundreds of fieldfares, redwings, wood-pigeons, stock-doves, green plover, starlings, grey crows, blackbirds, skylarks and bramblings were watched passing through. One unusual visitor to the island on November 7th was a great spotted woodpecker, the first recorded there.

BLAKENEY POINT.

(Notes from the diary of the Warden, Ted Eales).

Wildfowl generally were not as numerous as usual during the winter, and there were fewer Brent geese in the harbour, especially during January. One or two of these and some wigeon remained until early April.

Flocks of snow-buntings and a few shore-larks frequented the shingle ridges and were seen from time to time. Most of them left earlier than usual, although one party of ten shore-larks was seen on the Beachway on April 30th. Other records for January are of a long-tailed duck in the harbour on the 21st, mergansers and a scaup on the 29th, and of two merlins seen flying along the sandhills on the 29th.

During the fine warm weather of February numbers of sheld-duck were prospecting the dune areas in pairs. On the 5th a little gull was identified. In Morston a party of twenty waxwings were seen feeding on a hawthorn hedge on the 6th.

An early greenshank was heard and seen on the 22nd. A pintail, a scaup, and a great northern diver were in the harbour at the end of the month.

The North-West gale of March 1st, following closely on the new moon, caused serious flooding, filling all the low places with sea water, flattening the Far Point and shingle ridges and inundating the Old Lifeboat House and the huts to a depth of several feet. On the 26th there was a big immigration of wood-pigeons which were seen coming in over the sea from the north.

The spring migration was in full swing by mid-April. Terns were arriving and among the birds passing through was a black redstart on the 16th, and numbers of greenshank on the 17th.

On May 27th an osprey was disturbed eating a fish on the Far Point. Greenland wheatears were identified on the last day of the month.

Breeding Species.

Sandwich Tern.—The first birds were heard on April 6th as they passed over very high. They began to frequent the Point early in May but took some time to settle down and there were only two eggs on May 10th, although the number of birds present was estimated at 100. A total of fifty-one nests, in three colonies was eventually counted, an increase on the number last year. The first chicks were hatched on the Far Point on June 24th.

Common Tern.—These were first heard calling on April 14th, and arrived on the Point in large numbers on the 28th. The first chicks hatched on June 10th. Food was short at the beginning of the season and, as so commonly happens, a number of the earliest hatched young died. Later, after the whitebait had come inshore, all species of terns did well and young birds were flying on July 17th. The number of nests counted was 1,650.

Arctic Tern.—Three pairs were identified on the old ternery between the Far Point and the long ridge, and there were probably several more.

Little Tern.—These were widely scattered down the beach as far as the Hood Hills. The first birds were fishing in Morston creek on April 19th. The first eggs were laid on May 17th. 127 nests were found and there were probably more.

Ringed Plover.—Nest-making began on every suitable ridge early in April and the first eggs were found on the 22nd. Second clutches were laid on June 17th. Altogether eighty-seven nests were counted, about the usual number.

Oyster-catcher.—These also began "scraping" on April 2nd, but the first eggs were not laid until May 3rd. It was a good season and all the usual sites were used. Forty-nine nests were found.

Redshanks.—Thirty-two nests found, the first on May 2nd.

Sheld-duck.—Thirty pairs were working the hills on March 12th and nesting holes were occupied by April 7th. Several broods were seen in the harbour on June 22nd. It is estimated that fifty-five pairs bred, rather more than last season.

French Partridge.—A nest with eleven eggs was found on the long hills on June 23rd.

Roseate terns did not nest on the Point this year. One was seen and heard on June 13th and 18th and on July 4th. At the end of August a roseate was seen fishing in the harbour with one young bird which was still relying on the parent for food. It is probable that a pair bred further along the coast to the west. Terns have nested between Wells and Stiffkey for many years, but this area is covered by the Stiffkey range and cannot now be visited.

A single eider duck was in the harbour on July 13th, an unusual time for one to be seen inshore in Norfolk.

During September the autumn migration of small birds was seen to great advantage and reached its climax at the end of the month. A number of visiting ornithologists frequented the Point, and the ridge which connects it with Cley at this time, and some of their records are included in the list at the end of the report. Eales saw a bluethroat in the Suaeda bushes near

the "Britannia" on September 10th and three on the 12th, one of which he believed to be a white-spotted bluethroat.

In October a flock of 200 wigeon arrived on the 5th and a few Brent geese were in the harbour. An east to west movement of green plovers and starlings took place on the 13th; of redwings and bramblings on the 27th and grey crows on the 29th. A woodcock was flushed on the Far Point on October 27th and several were there on November 5th.

The first large party of wintering curlews arrived on November 1st. Sheld-duck usually present in large numbers before November were very late in arriving this season.

CLEY AND SALTHOUSE.

(Monthly records from the diary of W. F. Bishop).

January.

The bearded tits which arrived in October 1948 were still on the marshes in the New Year. They were frequently heard, and were seen on two occasions feeding on reeds freshly cut for them. On the 6th a female hen-harrier spent some time hunting over the marsh. A party of thirty-eight shore-larks was seen on the 8th feeding along the north boundary, a favourite place for them. Three waxwings were busy eating hawthorn berries on a fence of Cley Hall Farm on the 13th. A notable winter visitor this month was an Iceland Gull, identified on the beach on the 17th. A rough-legged buzzard was seen on the 28th.

February.

After the first few days mild weather set in and continued almost unbroken until the last week of the month. On the 6th Salthouse marsh was full of a number of the common waders, dunlin, ringed-plover, redshanks and grey plover, estimated at quite 1,000 birds. Redwings and Fieldfares were also present in large flocks on the ploughed fields of Cley Hall Farm. On the 16th, a spring-like day, a bittern was heard booming for the first time, and a snipe was drumming.

Green Plover invaded the marshes again on the 18th after being absent during the previous winter months. On the last day of the month three bearded tits were seen again. A strong W.N.W. wind was blowing, the beginning of a disastrous storm.

March.

The strong wind veered to N.W. in the early hours of March 1st and reached full gale force. At high tide the sea poured over the beaches all the way from Blakeney Point to Weybourne and the villages of Salthouse, Cley and Morston, and the low parts of Blakeney, were all flooded. The East boundary bank of the Cley marsh was breached in five places and the flood water forced a way out through the beach, forming a channel, through which subsequent tides flowed in and out. The marsh was submerged under six to seven feet of water and all bird-life on it was driven inland. Bearded tits were seen running like mice along the bottom of the roadside hedge of Bishop's garden with snow-buntings, water rails, and water-hens; shore-larks and bitterns were seen on the coast road; and on the following day two bitterns were found in the lee of a wood on Cley Hall Farm. The water subsided quickly over the greater part of the marsh and on the 3rd it was full of duck, mostly mallard and teal with a few shovelers and wigeon. On the 5th a mallard's nest was found with the bird sitting on nine eggs. A little crake was seen near the Hut on the 8th.

A strong north wind corresponding with the full moon on the 14th caused further scouring of the gap through the beach and the marsh was again flooded to a depth of four feet.

A pair of kingfishers were seen flying down the Main Drain on the 21st. The first wheatear arrived on the 22nd. On the 24th three bitterns were again flying round the marsh, and on the 29th two were booming, each time making four successive booms. The first garganey teal of the season arrived on Cley marsh on the 29th, and on the same day a reeve was seen at Salthouse and a black redstart in the garden of the Watcher's Cottage.

April.

The beginning of the month was cold with Easterly winds and some fog. A chiffchaff alighted on the garden fence of Watcher's Cottage on the 1st. The garganeys on the marsh increased to five and there was also a number of shovelers about. On the 2nd Sandwich terns arrived and the first yellow wagtail was seen. These were followed on the 5th by a swallow and a house-martin, and on the 6th by a sand-martin.

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Water Rail looking to see if the coast is clear.

On April 8th a westerly gale forced the tide through the beach gap again flooding the marsh to a depth of six inches. The same evening a large party of 5-600 Sandwich terns were on the Cley marshes, the first time they have been seen to rest here. On the 11th a bittern's nest which looked as if it had been under water, was found to have one egg, and a second one two days later. Spring migration was in full swing by the middle of the month and among the birds seen was a white wagtail, a black redstart and several whinchats. Waders were also passing through in considerable numbers notably whimbrel. Three black-tailed godwits, several reeves and two ruffs arrived on the marsh on the 15th. Garganey teal were seen frequently but did not stay long apparently not liking the salt condition of the marsh. Only one pair remained to breed.

May.

Waders made a good show on Salthouse at the beginning of the month, among them turnstones, bar-tailed godwits, knot and greenshanks, and there were twelve reeves and three ruffs on the Cley marsh. A party of late shore-larks was on the N. boundary on the 5th but the birds were not seen after this date. A second bittern's nest with five eggs was found on the 6th. The eggs of the first one began hatching on the 8th. On the 16th four bitterns were in the air over the marsh, while another was booming from a reed-bed and one was sitting. Among the many birds of passage seen during May was a dusky redshank on the 10th, a purple sandpiper at Salthouse on the same day, twelve black terns and a Temminck's stint on the 17th, a little stint on the 23rd, and a spoonbill on the 30th.

On the 18th Bishop heard the cat-like call of golden oriole coming from Cley Hall Wood. On the next day he heard it again, followed this time by the whistle of the cock bird. Unfortunately, he did not see either, but on the 21st an oriole was seen not far off, along the Cley—Holt road by Mr. R. P. Bagnall-Oakeley.

June.

It was possible to assess the number of breeding birds in the area this month, among them four pairs of bitterns, one pair of garganey teal, twenty pairs of yellow wagtails, eighteen pairs

of common terns (on Salthouse marsh), two pairs of red-backed shrikes and four pairs of stone-curlews.

A reeve caused some excitement by remaining on the marsh for three weeks from the 4th—25th, but hope that it might nest was not fulfilled. The call of a crake unknown to Bishop was heard coming from a reed-bed near the Cottage on the 13th, but he failed to flush the bird. Later it moved to the reeds round the Big Pool. This was almost certainly the bird identified by Mrs. R. F. Meiklejohn as a Baillon's crake. A spoonbill arrived on the 20th and was seen resting on the marsh in company with some herons. Later it moved to Salthouse to feed and remained in the area until the 30th.

JULY.

The marsh was very dry by this time as the result of the summer drought. A water-rail with a brood of young was seen on the 5th. There were five species of duck on the Big Pool on the 11th, mallard, teal, garganey pintail and shoveler. Shovelers were noticeably fewer than usual this season.

Green sandpipers passed through in large numbers and were to be found on every pool at the end of the month. Greenshank and whimbrel were also numerous ; and gannets offshore were passing eastward.

AUGUST.

The autumn movement of waders gained speed during this month. On the 1st a wood sandpiper was seen ; also a number of green and common sandpipers and a little stint. An early purple sandpiper first seen at Salthouse on the 14th was caught and ringed on the 18th, and on the 29th there were two. A Temminck's stint was identified in a small pool near the Cottage on the 25th, and a dusky redshank was feeding in a pool on the N. boundary on the 31st. The first wigeon of the season arrived on the Big Pool on the 3rd ; and by contrast a turtle dove's nest with eggs was found on Cley Hall Farm. A noticeable movement of small birds was seen on the 27th, among them numbers of pied flycatchers, redstarts and whinchats. Fifteen pied flycatchers were seen flying about the reed-beds.

SEPTEMBER.

The high-light of this month was the arrival of a little ringed plover at Salthouse which was identified on the 1st by Major Daukes and afterwards seen by a number of interested visitors. It remained for some time and was joined by a second bird on the 8th. Other waders at Salthouse on 6th were three black-tailed godwits, four dusky redshanks and three ruffs. On the same day there were seven species of duck on the Big Pool—mallard, wigeon, shoveler, garganey, and common teal, pintail and gadwall.

A little gull offshore was identified on the 8th. A tawny pipit was also seen on the 8th near the N. boundary (this bird was first identified by Mrs. R. F. Meiklejohn on the 5th). Numbers of small birds were seen again on the 11th including a black redstart and at least thirty common redstarts. A crake believed to be a Baillon's was seen on the 14th, possibly the bird which was heard calling during June. A grasshopper warbler was seen along the Main Drain and three golden plover were on the marsh on the 14th. The first snow-buntings arrived on the 19th, redwings on the 23rd and a party of thirty shore-larks on the 29th. A hen-harrier was hunting over the marsh on the 28th.

OCTOBER.

Green plovers, rooks and starlings were passing towards the west on the first day of the month. A marsh harrier of uniform chocolate colour with yellow legs was seen at close range on the 2nd. On the 4th two little buntings on the East Bank were identified. A female scaup was in the Freshwater Drain near the Cottage on the 12th. Green sandpipers were still on the marsh on the 15th. Swallows and house martins, estimated at 150 birds, were flying round the cottage in the late afternoon of the 19th and a few were seen on the 26th and 29th.

NOVEMBER.

A single swallow was flying round the cottage on the 1st, the latest record for the season. A hen-harrier was seen to swoop down on a covey of partridges on the arable field at the N.W. corner of the marsh killing and eating one of them. On the 24th a heron was watched to kill a full grown rat, which it then swallowed.

A lesser spotted woodpecker, rarely seen in this district, was in Cley Hall Wood on the 21st. The moderate easterly winds of the last week of November brought in several woodcock.

DECEMBER.

A large flock of snow-buntings arrived on the N. boundary in early September. They were attracted to the area near the ringing traps by seed thrown down for them and a number entered the traps and were ringed. A hen-harrier was hunting over the marsh on December 12th and was again seen to take a full-grown partridge. A small party of nine pink-footed geese was feeding on the marsh in the early morning of December 14th.

BIRD NOTES FROM HICKLING.

BY E. PIGGIN.

It was an open winter on Hickling Broad and coots from overseas which were almost completely absent in 1948 again arrived in considerable force. Duck were also present in fair numbers and these included mallard, wigeon, shoveler, teal, pochard and tufted : also common scoters with one velvet scoter among them.

In February a Great Northern Diver was seen in Whiteslea water and remained there for two days.

PASSAGE MIGRANTS.

Spoonbill.—One arrived on Deary's marsh on March 25th. It moved to Rush Hills next day, and was in the area until April 8th.

Black Redstart.—One was seen at Whiteslea on March 25th.

Ruffs.—The first to be seen in the Spring were two ruffs and three reeves on Deary's marsh on April 5th. Others were noted on May 12th.

Black-tailed godwit.—One seen on April 14th and another on Rush Hills on April 22nd.

Honey Buzzard.—A buzzard believed to be of this species was seen over Whiteslea on April 16th.

Black Tern.—The first was seen over Heigham Corner on May 12th and fifteen were over the Broad on the 14th.

Wood sandpiper.—Two identified on May 12th.

Red-breasted flycatcher.—One was seen on May 13th by George Bishop.

Dusky Redshank—One in Rush Hills on May 14th.

Osprey.—One was seen flying over the Broad on May 24th, and next day it was resting on a post near Swim Coots, where it was stalked to within forty yards.

Greenshank.—A number passed through in April and fourteen were noted in one week.

Breeding Species.

Bearded Tit.—A few were seen occasionally during the winter and more frequently in March. A nest with five young was found on April 13th, and a second one with six young on May 9th. Another pair were seen looking for a nesting site on May 12th. On May 15th young birds were flying round Whiteslea and two more which appeared very strong on the wing, were near Miss Turner's island. A third nest containing six eggs was found on June 2nd. The breeding season was a remarkably good one and in September the number of bearded tits on the Broad was estimated at fifty.

Warblers.—Grasshopper, Sedge- and Reed-warblers were plentiful and had a very successful season.

Marsh-harrier.—One or two birds wintered in Norfolk and were seen from time to time. More arrived in April and were paired by the middle of the month. On April 23rd two pairs were building nests, one on Bell's marsh and one in Warnbush. The first nest with four eggs was found on April 28th and a second with three eggs on May 1st. This eventually contained a clutch of six eggs from which six young were successfully reared. Another pair of birds were seen building near the Sound on May 4th, but this was not completed.

Montagu's Harrier.—The first arrivals were seen on April 19th, a week later than usual, but although they were over the marshes frequently, none stopped to nest at Hickling.

Duck.—Garganey teal were first seen on Swim Coots on March 25th. Two nests were found, one of which contained six eggs on May 2nd. At one time twelve pairs were feeding on the wader grounds.

Two shoveler's nests each with four eggs were found on April 24th. The number of these, and of breeding mallard was about normal and both species had a successful season.

Bittern.—The first boom was heard on March 11th. A nest with four young was found on May 10th and another on May 28th contained three eggs and two young. These were the only nests looked for, but there were several more breeding pairs, and on May 12th more birds were seen in the air at the same time. The last time booming was noted was on June 23rd.

Redshank.—It was not a good season for waders because the marshes were so dry, but a fair number of Redshanks' nests were found.

Green Plover.—About the same number of pairs as last year.

Water-rail.—No nests were looked for, but there were the usual number of breeding birds.

Great Crested Grebe.—These also had a very good season; six nests were found and all hatched successfully.

Owls.—The five common species, barn, short-eared, long-eared, little and tawny; all bred at Hickling this summer.

BIRD NOTES FROM HORSEY.

By Major A. Buxton.

Bitterns seem to have had a remarkably good breeding season. Three nests were found containing five, five and three eggs, and from these five, four and two young walked off in good health. One chick from a nest of five died and there was one rotten egg in the nest of three. Another family of five young whose nest was never found was seen with a parent on a path near Horsey Staithe, and one of the old birds was watched by the mill-man, Arthur Dove, ducking and diving between the sails of a cluster of boats as it flew past them. The localities of two other nests were known, which makes a total

of at least six nests in this neighbourhood. A good deal of sparring high in the air between bitterns was again noticed and it is presumed that this is between rival cocks.

No bearded tit was seen at Horsey in the winter of 1948-49 or this summer.

Water-rails have for the first time since the sea flood in 1938 come back in full force to breed. A pair in Starch Grass behaved in a peculiar way. A hide was put up by their first nest and the birds were photographed. It was noticed that one of them (whether cock or hen is not known) was fussy about the eggs, and kept picking up an egg and putting it down again either in the nest, on the side of it, and even outside it. All went well and the young left the nest. In due course the same pair, apparently, nested again about ten yards away from the site of the first nest and again a hide was put up. The growth of reed behind their second nest was thin and when it was opened up in front for photography a draught was apparently caused, which the birds disliked. While a photographer was in the hide the bird off the nest transferred material about one foot to the rear and slightly to one side and built a new nest, using in doing so most of the material of the old one. The bird incubating the eggs passed them back one by one to the bird behind and within one hour the operation was completed and all the eggs were being incubated in the second nest. I meant to be present when they hatched, but the birds were too quick for me, and the young had just left when I arrived. A loud and angry growl from a parent just behind the nest greeted me, and after a short search in the reed I found one of the young. Young Water-rails were Jim Vincent's favourite chicks, and I agree with him.

Another case of change of site and transfer of material occurred by my house. A pair of spotted flycatchers nested, as they have done for several years, on an iron girder across the front of the garage. After they had laid a cold north wind blew for several days straight along this girder. Whether for this reason or because of some other disturbance, the birds transferred all the nest to the fork of a rose bush growing up the wall of a house ten yards away. Nobody saw them move an egg and it is believed that those in the second nest were not the same as in the first.

The story of a cock marsh harrier, remarkable in appearance and also for his polygamous habits has been told in previous issues of this report. In 1947 he had two hens and both nested at Horsey within 600 yards of each other. In 1948 this cock certainly had two and is believed to have had three hens. He spent the winter in the neighbourhood and in the Spring mated with a hen in Brayden marshes, a well-known bird which nested early. A second hen flirted with him though he seemed to ignore her. Later another hen nested to the south and the cock which fed her was so outstanding in appearance that we believed it to be the same famous character. On June 8th when there were five young in the Brayden nest and the five eggs in the other one were on the point of hatching, careful watch was kept but no cock bird was seen to come near either. In the absence of the cock both hens were compelled to hunt for food themselves and it is a mystery how the hen, busy over the delicate business of hatching her eggs, succeeded in doing so. All five eggs hatched though one of the young died at about a week old. The five young from the other nest thrived and flew. Soon after the disappearance of the cock Mr. Borrett of Eastfield Farm, Hickling, sent me a ring taken from a harrier that he had found dead in his fields. The ring proved to be one used by Jim Vincent in 1943, but he kept no records of birds ringed that year and enquiries failed to prove whether the bird was a marsh or a Montagu's, a cock or a hen, though from the description of the wings it was probably a cock. The body was torn about by other birds. Just before his disappearance the remarkable cock marsh harrier demonstrated against me and a young Swiss naturalist when we went to look at one of his nests and came within easy gun-shot. He may have done the same to someone else and it is not a safe thing for a hawk to do in Norfolk. Quite a number of young marsh harrier cocks appeared in the spring but this old warrior soon cleared the air until he was alone in his glory.

Several cock Montagues arrived but there was only one hen. In addition to her mate another cock was constantly present and hung about round the nest after incubation had started. Montagues seem to be very tolerant of this kind of behaviour. The hen, unlike last year's bird, was very wild and never became friendly. Four young were reared.

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Knots feeding in pools left by the Tide.

There were very few short-eared owls during the winter, and only one pair in the spring which nested to the north of the Horsey boundary but frequently hunted on our marshes. Horsey church tower contained the nests of kestrel, barn owl and jackdaw, and Mill nests of kestrel, stock-dove, swallow and pied wagtail. No osprey was seen over Horsey mere this summer.

Orioles appeared on two occasions, one very subdued pair stayed for about half an hour on May 25th, immediately after I had heard of a pair at Hickling. A single cock on June 15th was first heard and seen just east of my garden, and later at Ford's farm where a lady described " a black and yellow bird singing like a blackbird in the orchard."

In every season some particular bird seems to have a record year. In 1948 these were whitethroats, in 1949 linnets. There is little low covert for nesting at Horsey since the sea-flood, nevertheless linnets swarmed, and the only nest I saw was built at the foot of a small bramble which provided hardly any cover. In April a nightingale sang in Horsey Hall garden from 7 a.m. to 2 p.m., the first time during the past eighteen years that one has been noticed here. A pair bred at Somerton this year and another at Lessingham, a little further north near the coast. In 1948 two pairs of chiffchaffs nested in the garden for the first time in my knowledge, but none bred there this year.

During April, May and June Horsey Hall garden was crowded with the dove family, woodpigeons, stock-doves and turtle doves, and cooing was incessant. Pigeons are now shot in many places during the spring and summer, and the fact that they are not disturbed at Horsey in the nesting season may account for their increase.

We are still short of song and missel thrushes and wrens which were decimated in the winter of 1947, and the same is true of coots, waterhens and woodpeckers. No woodpecker has nested here since and their visits are very few. A pair of red-backed shrikes bred at Horsey for the first time since the flood.

On September 7th Mr. G. Crees heard a note which he remembered from Switzerland, " hoo, hoo hoo," rather like a

despondent cuckoo. He recalled that it was a cock hoopoe and soon found the bird on the pony paddock at the bottom of the garden.

Probably owing to a lack of seed of their favourite weed, diving duck were very few on Horsey Mere during the winter. A fair number of mallard nested but no shoveler, garganey nor common teal. A number of dead frogs were found bitten in every case under the throat, but otherwise untouched. One day Mr. Crees, the keeper, saw a stoat with one and it is suspected that stoats kill them for sport.

SOME OBSERVATIONS ON THE NESTING HABITS OF THE SPOTTED FLYCATCHER.

By B. B. Riviere.

For the second year in succession two pairs of Spotted Flycatchers nested in my garden in 1949 in open fronted wooden boxes hung up on walls for their accommodation—one amongst a Japonica and one amongst an Albertine Rose. Both pairs took possession of their boxes almost immediately upon arrival which suggests that they—or at least one of each pair—were the same birds which had nested in them the year before. Both pairs arrived rather later than usual and it was not until the last week in May that nest-building commenced. The nest box in the Japonica was in a position unsuitable for watching, and the history of this pair can be related very shortly. The first egg was laid on June 1st and the fourth and last of the clutch on June 4th, on which day the female started sitting. On June 15th, the eggs were taken and the nest pulled out, probably by a Jay or possibly a rat or mouse. After prospecting various other possible sites the pair eventually returned to the box and rebuilt their nest, the remains of which had been put back. The first egg was laid on July 9th, and on 13th the hen started to incubate her second clutch of four. All four eggs hatched on July 25th—an incubation period of 12 days, counting as the first the day on which incubation commenced. The four young birds left the nest between 11 a.m. and 12 noon on August 7th, giving a fledging period of thirteen days, reckoning as the first day the day on which they hatched.

The box in the Albertine Rose was in an ideal position for observation, being on a wall immediately opposite and below my dressing-room window, a position of which I took full advantage at the cost of being frequently late for breakfast! The opportunity was also prolonged by the fact that this pair reared two broods.

NEST-BUILDING.

The female started building early in the morning of May 29th, and was still building in the afternoon. The material brought to the nest was moss, lichen and cobwebs, and I watched her stripping lichen from the trunk of a walnut tree and gathering spider's webs from the stable windows. The cock took no part, though occasionally he accompanied the hen, sat on the edge of the box, and looked in. Throughout the whole period I never saw but one bird building and if indeed the cock, as stated in "The Practical Handbook," takes a share, it must be a very small one.

The Flycatcher's method of building was rather remarkable, the beautifully neat and symetrical cup of the nest being fashioned almost solely by a series of shuffling, scraping and pushing movements of her body from inside it. After each arrival with fresh material she sat in the middle and, turning round and round with a "shuffling" motion, forced her breast and the butts of her wings against the growing rim of the nest. This, of course, forced the material outwards and to counteract this, in between each bout of shuffling, she would reach over and pull material from outside, over the rim, into the inside of the nest. In this way the material of the outside and the inside of the nest must have changed places several times during the course of its construction. Never once did I see her thread or weave material with her beak, yet the completed cup had almost the firmness and consistence of felt. The front rim of the nest was built up first, then the sides, and lastly the back. The whole rim was completed before any flooring was added and the final lining was of hair and red knitting wool. On May 31st and again on June 1st the nest was found pulled out and lying on the ground. It was quickly replaced and the bird went on building. The mystery was solved on June 2nd when a Tree Sparrow, a large colony of

which nest under the eaves of the house and stables, was seen sitting in the nest and deliberately pulling the fabric to pieces, while the two poor Flycatchers hovered helplessly in front of the box. The culprit was marked down as it flew on to the gutter of the house and duly despatched with a '410, after which peace reigned once more and the nest was completed on June 3rd, five days after its commencement. The first egg was laid on June 4th and on 8th the hen started sitting on a clutch of five.

INCUBATION.

Although "The Practical Handbook" states (on the authority of J. H. Owen) that the male Spotted Flycatcher takes a share in incubation, I feel pretty sure that the male of this pair did not do so. They were under such constant observation that had it been so I think I must have seen the pair change places on the nest, and this I never saw. When the sitting bird, as she often did, left the nest for short periods it was, of course, not always possible to be sure that it was the same bird that returned. It was, however, possible upon several occasions when the mate of the sitting bird happened to be in view during the time of her absence and in these cases it was always the bird which had been sitting which returned to nest.

During incubation the cock Flycatcher fed the hen on the nest, but not, it seemed, with any degree of regularity. On June 20th, the day before the first clutch hatched, he fed her four times in an hour, but during the incubation of the second clutch I only saw him feed her upon three occasions. The hen had, therefore, to leave the nest at fairly frequent intervals in order to obtain food, and the longest period of continuous brooding I was able to observe was fifty-five minutes.

A few examples of periods of brooding and absence from the nest while under observation may here be given :—

Third day of incubation, periods of brooding five minutes and eighteen minutes, period of absence seven minutes.

Fifth day, periods of brooding twenty-four minutes and twenty-five minutes, periods of absence six minutes and six minutes.

Sixth day, period of brooding fifty-five minutes, period of absence ten minutes.

Ninth day, period of brooding forty-seven minutes and eleven minutes, periods of absence five minutes and seven minutes.

Twelfth day, periods of brooding fifteen minutes and sixteen minutes, periods of absence eight and four minutes.

While sitting the hen passed the time in various ways. Sometimes she was very wide awake, following with eager eyes the flight of insects past the nest. Sometimes she preened her feathers and occasionally she tucked her bill into her scapular feathers and went to sleep. From time to time she turned her eggs with her bill, half standing up to do so. There did not seem to be any regularity about this egg turning. Sometimes an hour would pass without her doing so, but during an hour's watching on the day before they hatched she turned them four times. She took no notice of a cock Greenfinch, which on one occasion alighted a foot away from the nest.

At 10 a.m. on June 21st, three of the five eggs had hatched, giving an incubation period of thirteen days. The other two eggs clear. During most of the fledging period of this first brood I was away from home and can only record that two of the young left the nest on July 5th and the third on July 6th. Their fledging periods were therefore fourteen and fifteen days respectively.

On July 9th the hen was taking fresh building material to the nest : while the cock was seen still feeding one of the young ones. The nest was relined and the first egg laid on July 12th, and on 15th the hen was incubating a second clutch of four. The second incubation followed the same pattern as the first with again no evidence of the cock taking any part in it.

FLEDGING.

Two young had hatched at 11 a.m. on July 27th (incubation period twelve days) and the remaining two at the same time on 28th, though whether these last had done so later on the previous day I do not know. On 27th between 11 a.m. and 12.15 p.m. the hen was on the nest for periods twenty-five, fifteen, three, and thirty-one minutes, and the nestlings were fed twice, once

by the cock and once by the hen. On the second day, during an hour's watching, they were fed nine times, seven times by the hen and twice by the cock. Periods of brooding were five, two, five, ten, ten and five minutes, and periods of absence two, three, three, four, one and ten minutes. On the fourth day they were fed fourteen times in an hour, nine times by the cock and five times by the hen, and were brooded for periods of twenty-five, seven, two, and six minutes. When the male brought food while the female was brooding she usually flew off and left him to feed, but occasionally she sat tight, in which case he passed the food to her and she then stood up and fed the nestlings herself. The actual process of feeding the nestlings was often difficult to see owing to the bird's backs being usually towards me, but I satisfied myself that often two and occasionally three, were fed at one visit, which would indicate that the parents sometimes carried in their bills several insects at a time. Several times I noticed a parent, apart from feeding, gently peck at the open mouth of a nestling, and I wondered if this was to remove particles of unswallowed food. The faecal sacs were swallowed by both old birds during the first three days. On the fourth day they were sometimes swallowed and sometimes removed, after which they were always carried away. On the sixth day, during an hour's watching, the nestlings were brooded for fifteen minutes, and left unbrooded for forty-five minutes. They were unfed for nineteen minutes, but were then fed thirteen times in twenty minutes! On the eighth day they were brooded for thirty minutes and later fed eighteen times in forty-five minutes. They were still being fed at 9 p.m., fifteen minutes after sunset. On August 6th at eleven days' old the young birds were well feathered and stretching their wings. They were fed fourteen times in thirty minutes, but were not brooded, nor did the hen roost on the nest that night.

Two of the young ones left the nest on August 11th and the remaining two next day. It will be remembered that two had hatched later—possibly a day later than the other two. If it was indeed a day later it would give a fledging period for all four of fifteen days. If, however, as is equally possible, the last two hatched only a few hours later than the others, the fledging period of the last two to leave the nest would be

sixteen days, an abnormally long one. Even so, some of these nestlings looked hardly old enough to leave. I saw what I took to be the last one to fly the day after it left the nest. It was sitting quite alone on an iron railing some fifty yards from the nest. With its ridiculously short tail and some down still adhering to its head it looked rather a pathetic little object, and I thought that unless it could keep in touch with its parents for the next few days its chances of survival seemed slender indeed.

THE SCROBY SANDS.

Report from R. H. Harrison.

The first trip to the Scroby Sands this year was made on May 23rd. It was apparent then that the gales of the winter and early spring had changed it drastically; all the high points had disappeared and an old wreck which was almost completely buried last summer was showing its skeleton hulk well above the sand. There were several hundreds of terns flying round and eggs of both Sandwich and common were found.

On a second visit on June 5th it was found that the Sandwich terns far outnumbered the common and 170 nests of the former were counted to thirty of the latter. There was only time for this census to be taken over about half of the island. A few little terns were also found to be nesting in the north-west corner of the bank.

Soon afterwards high tides washed over the sands again and all the nests were destroyed. On June 26th only a few birds remained and although it appeared that some of the common terns were making fresh attempts to nest, there were no signs of the Sandwich terns doing so. On this occasion a large gathering of quite 300 Kittiwake gulls, both adults and immatures, were resting on the bank.

A final trip was made on September 25th, but owing to the high tide and the swell it was not possible to land, and it was apparent then that it may be several years before the terns are able to breed on the sandbank again with success.

MISCELLANEOUS NOTES.

Compiled by R. A. Richardson.

Raven

One seen flying over Cley on September 24th. The large size, heavy bill and unmistakable croak were all noted. (Mrs. R. F. Meiklejohn.)

Twite

Over fifty birds seen on a Breydon rond on October 16th. (M. J. Seago, P. W. Browne.)

Wood-Lark

Successful breeding took place near Sheringham and on Salthouse Heath, both recent extensions of range. (R. A. Richardson.)

[Tawney Pipit

A large pipit seen on Cley beach September 6th and 7th was described as follows:—Very Wag-tail like, long flesh-pink legs, slight superciliary stripe, unspotted breast. (Mrs. R. F. M.]

Blue-Headed Wagtail

A male with nine or ten yellow Wagtails at Cley on September 7th. (G. H. Hunt.)

Willow Tit

One seen at Bow Hill, Barford on January 12th. (R. G. Pettitt.)

One seen and heard at close quarters by Rockland Broad on February 19th. (G. F. B. Robinson, Paul D. Kirby) and on March 13th. (G. F. B. R.)

A bird excavating a nest-hole in a birch fence-post at Santon Downham on May 1st. The brood successfully fledged on June 13th or 14th. A second nest reported two miles away at Lynford. (E. M. Condor.)

Great Grey Shrike

One seen to fly in from the sea at Sheringham on January 22nd. (G. Marsham.)

One at Holkham on September 2nd. (David Jenkins, W. E. Kenrick.)

One at Binham on October 9th. (K. Bennett.)

One on heath country near South Creake on November 6th. (D.J.)

WAXWING

Five at Claxton near Rockland Broad from December 24th 1948 to January 1st, 1949. (E. A. Ellis.)

Twelve at Weybourne on January 30th. (Peter R. Clarke.)

Ten by Ranworth Inner Broad on November 20th. (P.D.K.)

Two at Wells on November 29th. (Dr. R. G. Ticehurst.)

Twenty-eight at Surlingham on Dec. 10th. (M.J.S.)

Twelve in Trafford Road, Norwich on December 12th. (C. D. J. Imrie.)

RED-BREASTED FLYCATCHER

One at a garden bird-bath in Gt. Yarmouth on August 25th, was decidedly smaller than accompanying Pied Flycatchers but behaved like them. The pale eye-rims were also noticeable. (Dr. L. Ley.)

One at The Hood, Blakeney Point, on September 21st. (Mr. Higgins.)

AQUATIC WARBLER

One at Cley on September 10th. (A. Daukes.)

REDSTART

A pair with fledged young among oaks near Salthouse Heath June 7th. (M. F. M. Meiklejohn.)

(Uncommon breeding species in Norfolk at the present time.)

BLACK REDSTART

A female or immature male on roof of a new house at Kirby Bedon on November 6th, 1948. (R.G.P.)

Female or immature at Cley from March 22nd–25th, and another on April 5th. (R.A.R.)

One on Caister Warren on May 1st. (M.J.S., P.W.B.)

Other Cley Birds were present as follows :—

Adult male in winter plumage from September 7th—24th ; four females or immatures on October 10th, (one remaining till the 11th).

A female or immature from October 14th—15th ; one from October 23rd—25th, and another on October 28th. (R.A.R.)

An adult male at Weybourne on October 9th. (P.R.C.)

BLUETHROAT

One at The Hood, Blakeney Point on September 22nd. (A. Stokes.)

HOOPOE

One in an apple tree at Holt on March 12th. Thin slightly down-curved bill ; ruffled crown ; distinctly barred wings ; pale breast. Tail gently raised and lowered at fairly regular intervals. (G. H. C. Byford.)

Although the date is rather early and the fan-shaped crest was reduced to a ruffle (perhaps due to an accident) this bird seems to have been satisfactorily identified.

HOBBY

One seen at Cley on June 7th. (M.F.M.M.)

WHITE-TAILED EAGLE

An immature sea eagle was first seen working over the bar of Blakeney harbour on December 10th. Since then until the present time (Jan. 3rd, 1950) it has remained in the coastal area between Weybourne and Burnham Overy, and has been identified by a number of observers including the Watchers of Blakeney Point, Cley and Scolt Head Island. It is usually seen flying about a mile out to sea, but on several occasions has also been seen resting on the tide-line at Blakeney Point.

OSPREY

One on the lake at Harford from August 2nd—9th. (Mrs. E. Macalister.)

SPOONBILL

A grand adult on Breydon on May 22nd, feeding in the shallows close by the Channel. (M.J.S., P.W.B.)

LESSER WHITE-FRONTED GOOSE

An adult male was shot on Halvergate marshes, Breydon, on January 24th and is now in the Castle Museum. (See British Birds, Vol. XLII.)

BEAN GOOSE

A flock of forty-six arrived on the Buckenham marshes on December 28th, 1948 and later increased to 150. They left in mid-March 1949. (R. Harrison.)

PINTAIL

A pair nested " on an East Norfolk grazing marsh less than three miles from the sea." Photographs and specimens of the down were taken. (R.H., G. Warner, G.F.B.R.)

LEACHE'S FORK-TAILED PETREL

A female, flying east against a strong S.W. wind struck the telegraph wires beside the Acle New Road on November 13th. (R.H.)

FULMAR

The colony near Sheringham seems well established with eleven nesting sites, their position on the high cliffs preventing human interference.

About twenty birds were first seen on February 4th and increased to forty by the 18th. (J. and G. Marsham.)

Six pairs were present on the high cliffs between Mundesley and Trimingham from April to June but did not breed there. (D. Bowden.)

SPOTTED REDSHANK

Single birds were seen on Breydon Water on April 3rd and 16th and two on April 13th. Single birds seen on May 6th and 13th were both in breeding plumage. (M.J.S., P.W.B.)

LITTLE RINGED PLOVER

One near Pinchen's creek, Blakeney on September 6th. Among the features noted were absurd tameness, total absence of wing-bar, flesh coloured legs, dark bill, small size and thin high pitched call-note, mantle paler than adult ringed plover. (G.H.H.)

The same bird, (or another) seen at Cley on September 1st. (A.D., Miss C. James, Mr. and Mrs. C. Rose.)

KENTISH PLOVER

A male observed in bright sunshine for over an hour on the South wall of Breydon on May 22nd. Details noted were smaller size compared with nearby ringed plover, blackish legs,

black bill, sandy-brown back, rufous crown, black patch on each side of white breast, narrow black line through each eye, white above base of bill then narrow black. (M.J.S. and P.W. B.)

DOTTEREL

One at Salthouse on September 19th. (A.D.)

AVOCET

Two on Breydon on May 1st. (M.J.S., P.W.B.)

One on Breydon on June 6th and another on August 15th. (R.H.)

[LITTLE BUSTARD

A bird which may have been of this species was seen at Cley on two or three occasions in mid-July and again, possibly, in November, by Mr. Allen, a local farmer, who saw it feeding among poultry in an isolated stackyard some way from the road. It resembled a hen pheasant with a short tail and had long thick greenish legs. He did not notice any white on the wing in flight. Its cry a loud gruff noise, was heard by Mrs. R. F. Meiklejohn but she failed to see the bird.]

LITTLE GULL

An immature on Breydon on March 15th (R.H.). An immature on Barton Broad on April 3rd and 11th (R.G.P.). Two seen at the harbour mouth at Yarmouth on July 1st, one in beautiful breeding dress, stayed until July 16th. It is unusual to see this species in July (M.J.S., P.W.B.). An immature at Cley September 17th (G.H.H.). Another at Breydon, November 20th (M.J.S., P.W.B.). An immature at Cley November 22nd (C. Borrer.)

MEDITERRANEAN BLACK-HEADED GULL

A bird of this species in breeding plumage seen with other gulls following a plough at Blakeney during March. The head was black the hood reaching down over the nape, and the wing-tips showed little or no white. (C.B.)

GLAUCOUS GULL

An immature bird at Gt. Yarmouth December 4th. (P.D.K.)

Pomatorhine Skua

One off Cley on October 1st. The central tail feathers resembled feet projecting beyond the tail. (David Hunt.)

Little Auk

A very early bird seen close inshore off Cley Beach on September 7th. (G.H.H. and A.D.)

One in the Main Drain, Cley on November 15th following a northerly gale. Two seen off Cley Beach after strong N.W. winds on December 10th, 11th and 15th. (R.A.R.)

Spotted Crake

One at the south end of the East Bank of Cley Marsh on December 1st. It looked very brown spotted with white, and the buff under tail-coverts were seen as the bird dropped into a reed-bed. (Mrs. R. F. M. and Miss Steinthal.)

CLEY BIRD OBSERVATORY.

At the height of the autumn migration the Norfolk Naturalists Trust established a new bird observatory on Cley beach thus forging an important link in the chain of migration study stations operating round the coast of Britain. A Heligoland trap of the funnel type for the marking of migrant birds has been constructed, and incorporates the sheltered south wall of the derelict gun-emplacements. The ringing records and a small reference library are accommodated on the top floor of the adjacent Coastguards' look-out which commands a wide view of the sea and coastline from Sheringham to Wells. Over a hundred interested people have visited the Observatory during the first three months of its existence, many of them giving valuable assistance. The numbered identification rings issued in eight sizes by the British Trust for Ornithology, are of light and durable aluminium alloy and it cannot be over emphasised that a competently ringed bird suffers nothing more than the momentary discomfort of being handled. Mr. R. A. Richardson the Warden has had ten year's ringing experience and at Cley few birds are detained for longer than a minute. He will be pleased to reply to inquiries sent to him at Hill Top, Cley-next-the-Sea.

LIST OF BIRDS RINGED.

Species.	Trapped.	Nestlings.	Total.
Starling	1	—	1
Hawfinch	—	1	1
Greenfinch	—	7	7
Goldfinch	1	—	1
Linnet	11	5	16
Chaffinch	12	5	17
Brambling	2	—	2
Yellow Bunting	—	4	4
Reed-Bunting	9	3	12
Snow-Bunting	33	—	33
House-Sparrow	66	—	66
Tree-Sparrow	23	—	23
Sky-Lark	2	5	7
Meadow-Pipit	—	24	24
Rock-Pipit	1	—	1
Yellow Wagtail	—	5	5
Pied Wagtail	1	—	1
Great Tit	4	—	4
Blue Tit	27	—	27
Spotted Flycatcher ...	1	—	1
Pied Flycatcher	1	—	1
Goldcrest	7	—	7
Chiffchaff	—	7	7
Reed-Warbler	—	3	3
Song-Thrush	1	11	12
Blackbird	7	4	11
Wheatear	10	—	10
Whinchat	2	—	2
Redstart	4	—	4
Black Redstart	5	—	5
Nightingale	—	8	8
Robin	6	—	6
Hedge-Sparrow	1	1	2
Swallow	3	5	8
Short-eared Owl	—	2	2
Bittern	—	2	2
Dunlin	16	—	16
Purple Sandpiper—(the fiirst to be ringed in Britain)	1	—	1

Species.	Trapped.	Nestings.	Total.
Redshank	4	4	8
Ringed Plover	1	8	9
Lapwing	—	9	9
Oystercatcher	—	5	5
Common Tern	—	9	9
Black-headed Gull ...	—	1	1
Moorhen	1	—	1
Totals	263	139	402

402 Birds of 45 Species.

RECOVERIES.

Blue-Tit

A bird ringed in Norwich on December 21st, 1948 was killed by a cat at Brightlingsea, Essex on October 13th, 1949 having been tame and well known in the house. Sixty miles is an unusally long journey for a British Blue Tit. (R.A.R.)

Black-headed Gull

An immature bird, following a plough at Holm-next-the-Sea, in December, 1948 was trapped when earth turned by the plough-share fell on its feet. It was found to be wearing a Swedish ring and had been marked as a young bird on Eskilstorp Island, S. of Malmo on July 1st, 1948. (S. Frohawk.)

A bird with a Czech ring was picked up in Yarmouth on September 5th having been ringed at Pardubice, E. Bohemia on May 26th, 1948. (R.H.)

Another, an immature bird, was found in Yarmouth on September 12th and had been marked as a young bird also in Pardubice on May 10th, 1949. (R.H.)

Herring Gull

A bird at Sedgeford found wounded in December 1948 and subsequently destroyed, had been ringed in Augustenborg Fyord, S.E. Jutland, Denmark on July 11th, 1943. (T. H. Batch.)

Great Black-Backed Gull

An immature picked up on Breydon on March 17th had been ringed as a young bird on the island of Rott, near Stavanger, S.W. Norway on June 25th, 1948. (R.H.)

IV

BOTANICAL EXCURSION IN WEST NORFOLK.

Report by Eric L. Swann.

As a result of a suggestion by the Field Committee of the Botanical Society of the British Isles a four days' field-study of the flora of West Norfolk took place in mid-July. Forty-six members participated including Messrs. C. E. Hubbard, N. Y. Sandwith, and V. S. Summerhayes of the Kew Herbarium staff. The local leaders were Messrs. R. P. Libbey and E. L. Swann of King's Lynn. The party set off each day from King's Lynn and did not return until the evening.

Wolferton was the first area to be explored and members studied the flora of the salt-marshes, sand-dunes and shingle banks on the shore of the Wash between North Wootton and Snettisham. The extensive areas reclaimed from the sea and the use made of the Cordgrass (*Spartina townsendii*) in fixing and binding the mobile mud were studied. In 1910 a shipload of young plants was introduced at North Wootton and there is now an almost unbroken pure colony of many acres stretching from north of King's Lynn to Wolferton Creek. Here members were able to see not only the common Hard Grass, *Parapholis strigosus* (Dumort.) C. E. Hubbard, *Lepturus filiformis* of some authors, but also the rare *Parapholis incurvus* (L.) C. E. Hubbard; once known as *Lepturus incurvus*. The flora at Wolferton is a fluctuating one owing to the large areas of broken shingle as a result of many tons being carted away in the war years and the proximity of new arable land. This has resulted in a considerable increase in the population of weeds from arable land.

The afternoon was devoted to Dersingham Fen, parts of which are bog-peat, bordering the Scots pine and heather-clad hills of the main King's Lynn—Hunstanton road. It was hoped to find all three Sundews but only *Drosera rotundifolia* and *D. longifolia* were found. The Cranberry, in both fruiting forms, namely the usual red-coloured and the speckled (var. maculatus Lousley, "Berries uniformly covered with dark brownish-red speckles") together with a large clump of the Punctate Loosestrife (*Lysimachia punctata* L.) and a rare

variety of the Lesser Jointed Rush (*Juncus bulbosus* L.), var. *Kochii* (F. Schultz) Druce, were observed.

The second day was devoted to Roydon Common, Derby and Sugar Fens. The two fens are good examples of true sedge-fens and are similar to Wicken Fen in Cambridgeshire. On the Common various marsh orchids and their hybrids were studied and a new station for the rare Bog orchis (*Hammarbya paludosa* (L.) O. Kuntze (*Malaxis paludosa*) was discovered. Derby Fen provided a mixed flora including the sedge, (*Carex lasiocarpa* Ehrh.), the Pillwort (*Pilularia globulifera* L.), the Greater Spearwort (*Ranunculus lingua* L.), and the One-glumed Marsh Club Rush (*Eleocharis uniglumis* (Link) Schult.

East Winch Common was visited in the afternoon and search made unsuccessfully for the Shoreweed (*Litorella uniflora* (L.) Aschers.) The continual dry weather was evidently responsible for its absence. The Marsh Gentian (*Gentiana pneumonanthe* L.) was flowering well and, as a result of ploughing a small area and reseeding with a grass mixture suitable for a cricket pitch, the Viscid Bartsia (*Parentucellia viscosa* (L.) Caruel (*Bartsia viscosa*) has now to be recorded for the first time from this common. The seeds were apparently impurities in the mixture and a similar introduction of these plants has been recorded from a new village cricket pitch in Gloucestershire.

A diversion was made to arable land at Pentney to see the many plants of Swine Succory (*Arnoseris minima* (L.) Schweigg & Koerte) and one small clump of the Yellow Camomile (*Anthemis tinctoria* L.) at West Bilney. A visit was then paid to Castleacre Priory where the Wall Bedstraw (*Galium anglicum* Huds.) still persists on the ruins. Here the very rare grass, *Poa palustris* L. was pointed out. Before reaching King's Lynn a further stop was made by a heathy field at Bawsey where there is a large flourishing colony of the alien *Potentilla recta* L., and the uncommon grass, *Apera interrupta* (L.) Beauv., a native only of East Anglia, grows.

On the way to Holme-next-the-Sea on the third day a stop was made at the carstone quarry at Snettisham to view the many flowering plants of the Hoary Mullein (*Verbascum pulverulentum* L.). By its abundance here it would appear that this quarry is the dispersal centre for this plant which is of peculiar interest to Norfolk and Suffolk only. It was recorded as flowering abundantly about Norwich by Ray in 1670. At

Holme all the Sea-Lavenders were seen together with the One-glumed Fescue (*Vulpia membranacea* L.) Dum. (*Festuca uniglumis* Sol.) and species and varieties of the Sea Couch-grass (*Agropyron* spp.). A visit was then paid to the Overy Staithe dunes to study the coastal vegetation and dune-slacks. Here the most interesting plants were the Jersey Cudweed (*Gnaphalium luteoalbum* L.), the Wild Pea (*Lathyrus silvestris* L.) and masses of the Marsh Helleborine (*Epipactis palustris* (L.) Crantz. The dunes here are much older than those at Wolferton and of a more calcareous character due to the abundance of comminuted sea-shells. The party then drove through the park at Holkham where the many fine specimen trees and avenues of evergreen oaks were much admired. On the return journey a stop was made at Vincent Hills, West Newton, to find the Meadow Sage (*Salvia pratensis* L.) just finished flowering, Henbane (*Hyoscyamus niger* L.), and in a crop of Lucerne, a very rare adventive, the Hispid Mallow (*Althaea hirsuta* L.) was found. This constitutes a new record for West Norfolk.

The last day was spent in ' Breckland.' Owing to the large area involved most of the time was spent in roadside botanising at such chosen spots as Merton, in order to see the Berry-bearing Chickweed (*Cucubalus baccifer* L.) and East Harling Heath to find a few small colonies of the Spiked Speedwell (*Veronica spicata* L.). Longer time was spent on Barnham Cross Common to find the characteristic Breckland plants such as the Perennial Knawel (*Scleranthus perennis* L.), the Purple-stalked Timothy Grass (*Phleum pheoides* (L.) Karst., and the Field Wormwood (*Artemisia campestris* L.). On the return journey Santon was visited for the alien grass (*Bromus tectorum* L.) and stops were made at Stoke Ferry for the Alyssum which has been observed there for the past twenty years, (*Berteroa incana* (L) DC. (*Alyssum incanum* L.), and at Wormegay new housing estate in order to see the Wind-grass (*Apera spica-venti* (L.) Beauv.)

For permission to study the plants in their native habitats the members were extremely grateful to H.M. the King for facilities granted at Wolferton and Sandringham, to the Rt. Hon. the Earl of Leicester at Holkham, to Ralph Hodge, Esq., at Snettisham and to the Parish councillors of Roydon.

Eric L. Swann.

V

ROE DEER.

The Problem of the " Rings."

BY ANTHONY BUXTON.

Roe, which are the smallest of our three deer, weighing only about 40 lbs., seem to enjoy being peculiar and breaking all the normal rules for deer behaviour. For instance they are not gregarious, but go about in pairs or small parties ; they have no visible tail ; the bucks shed their horns in mid-winter and grow them again by April, instead of shedding in the spring and growing their horns in the summer like other deer ; and lastly they rut in the last week of July and the first fortnight of August, i.e. two months earlier than red deer and three months earlier than fallow. And yet roe fawns are born, as indeed they should be, at the most favourable moment—the end of May or beginning of June, at about the same time as fallow fawns and red deer calves. Red deer are about four times the size of roe and fallow are more than twice the size of roe, and yet have much shorter periods of gestation.

It may well be asked " How does that happen ? " That is the point of this article. The egg of a roe fertilized in the last week of July or the first fortnight of August does not, as in the case of most eggs of mammals, become almost immediately after fertilization attached to the wall of the uterus. It remains floating about unattended and unattached from that moment until mid-December, a period of four and a half months : once attached it develops normally. The largest known mammal's egg is, I am told, that of a sheep, much larger than a whale's egg, but still much smaller than a pin's head—in fact about the size of a dot made by the point of a pencil. This long period of delayed development and of vague floating about somewhere in the uterus must, one would imagine, be an extremely risky proceeding, at least for the egg : however the arrangement seems to work all right and so it does with certain other animals, which also go in for this delayed development,

e.g. badgers, stoats, certain martens, a black bear and armadillos. For all I know there may be others; for instance it is suspected in Pére David's deer, another freak "if ever a *freak* there was."

The reason for the delayed development is known. It is due to the fact that the egg does not get "implanted" in the wall of the uterus because the surface cells of the egg are not, during the period of delay, made sticky by the action of what is called a hormone—a biochemical something. This hormone for some reason does not get busy in a roe till December. When I asked a Norfolk doctor whether a hormone was a good angel in miniature, he replied "Yes, but there are bad ones."

What is the original cause which necessitates this strange and apparently risky delay in development? Surely it is the early date of the rut. Why on earth should roe rut in the end of July or beginning of August? Why not wait like red deer, fallow and others until the autumn? If a fallow can rut in November, why cannot a roe rut in December? A roe might argue that by some date in December he has shed his horns, but why shed your horns in December, when other deer keep theirs until the spring?

I must now relate what I have seen myself during the last two years at the beginning of August in Argyllshire. In 1947 I discovered a set of roe "rings" freshly used on a marshy flat. Roe "rings" are heavily tracked paths round bunches of rushes and other plants, made by the animals moving repeatedly along the same tracks in circles, figures of eight, etc. These particular "rings" were within ten yards of the only public road in the district where the roe were constantly disturbed by motor cars, cyclists, shepherds and their dogs. "Rings" in the same place were again used by a pair of roe at the rutting season in 1948 and 1949. In 1948, I found another set of rings used by another pair of roe some two miles away from the first site, and moreover watched this pair leave a wood at 7.30 p.m., go straight across the open some seven hundred yards to their rings and move about in them until dark. They were in the "rings" at dawn next morning and had presumably been there all night: they went back to the wood they had left twelve hours previously at 7.30 a.m. and returned

the next evening to the rings punctually at 7.30 p.m. On the first evening while at and near the rings I saw the buck serve the doe ten times, nine times in half an hour. I should no doubt have seen a similar performance on the second evening when I was in a freshly made hide at forty yards from the rings with a film camera fixed on a tripod. I could not however resist a shot before the light went and the buck lying just below me at thirty yards heard the camera and took his lady off with him. Even then they nearly returned half an hour later.

I saw on the first evening the apparent reason for the formation and shape of the "rings." The buck kept ducking under the doe's chin and also "riding her off" with his body, in particular his shoulder, just as at polo. This had the effect of perpetually stopping and turning the doe and so, as it seemed to me, causing her to move in regular circles and figures of eight round particular bunches of rushes: in fact it formed or helped to form the "rings."

The set of "rings" where I saw this happening was used again, as I expected it would be, in 1949 at the end of July and beginning of August. The weather was then very wet and stormy and the wind was almost invariably in the wrong quarter for stalking or observing the roe in their rings, and, although I did on one occasion watch a doe in the rings for over two hours, there was no buck with her. I did however on another evening watch with a telescope for 2½ hours a buck and doe on the same flat three hundred yards from these "rings." I saw the buck serve the doe three times in under ten minutes, when they disappeared together into bracken. After they had re-emerged into view he served her again. This was on August 12th.

I know therefore that one set of "rings" has been used during the rut for three years in succession and that another set of "rings" has been used for two years in succession. For all I know they may both have been used for three hundred years or more. One of those set of rings is in a place where the deer are constantly disturbed and yet they return year after year to this same spot within ten yards of the only main road in the district. There must therefore be some terrific draw to the rings in the last week of July and the first two weeks of August. What is the draw?

If that question can be answered we may have an explanation of the whole mysterious business. There is something at those " rings " which draws the roe to them like a magnet at that particular moment. If we could discover what it is, it may explain not only the *place* for the honeymoon but its *date*, and remember that it is the early date of the rut and of fertilization of the egg, which leads to all the complicated business of free floating minute egg and long delay in development in order that the fawns may be born at the right moment in the summer, instead of much too early in the year. There may be a similar reason for the parallel phenomenon in that other ridiculously mixed collection of animals including badgers and, of all things, armadillos.

Another fact, which seems to me of extreme interest was proved. No fawns were ever seen at or near the rings in July and August. And yet it is known that the doe watched with the buck in the rings in 1948, and the doe watched with the buck in 1949 had at least one fawn. Roe fawns at the end of July are only two months old and yet, when their mother goes to the rings at 7.30 p.m. and only returns from them twelve hours later, those fawns are left dumped all alone, unprotected. A German authority asserts that if the fawns try to follow the doe to the " rings," the buck prevents them doing so, if necessary with his horns, which sometimes results in fatal accidents to the fawns.

As a result of experiences in 1948, I got, rightly or wrongly, into my head the notion that *the draw to the rings is a plant or something to do with a plant.* Wherefore in 1949 although no botanist, I made a collection of plants from the two sets of " rings " and from the small area three hundred yards from one set of " rings " where I watched the buck and the doe mating in 1949. The plants were collected only from within a roe's reach from its fresh tracks in the rings and at the mating place. These three collections were sent to Mr. E. A. Ellis for identification. On hearing the result from him, I had a further search made for a particular plant—purple moor grass—at one set of " rings " and it was discovered there although I had missed it. The rings are given the titles which they have acquired, for reasons that need not be explained.

LIST OF PLANTS.

White Glen Rings.	Iron Stag Rings.	Mating Ground. (300 yards from Iron stag rings)
Modinia caerules (Purple Moor grass) infected with ergot	*Modinia caerulea* infected with ergot	*Modinia caerulea* infected with ergot
Juncus articulatus (Jointed Rush)	*Juncus articulatus*	*Juncus articulatus*
Carex Goodenowii (Goodenough's Sedge)	*Carex Goodenowii*	*Carex Goodenowii*
Filipendula ulmaria (Meadow Sweet)	*Potentilla erecta* (Tormentil)	*Potentilla erecta*
Penecio aquaticus (Marsh Ragwort)	*Succissa pratensis* Devil's-Bit scabious	*Succissa pratensis*
Holcus lanatus (Fog grass)	*Erica tetradix* (Cross leaved heath)	*Erica tetradix*
Gadium palustre (Marsh Bedstraw)	*Sutellaria minor* (Lesser skull-cap)	*Carex rostrata* (Bottle Sedge)
Rumex acebosa (Sorrel)	*Hydrocotyle vulgaris* (Marsh pennywort)	*Thuidium tamariscinum*
	Sphagnum SP (Bog moss)	Mosses *Hypnam cuspidatum* *Hypnam stellatum*

It will be noticed that three plants were in the collection from all three situations, but more important is the discovery that one of them, purple moor grass was in each case heavily infected with 'ergot,' a fungus named *Claviceps purpurea*. When Mr. Ellis made this discovery he asked, "Is this what you are looking for?" Is it what the roe are looking for? That is the point. I know nothing about purple moor grass and less than that about "ergot," but enquiries show that "ergot" is used in obstetrics and gynaecology. It induces contraction of the uterus and may cause abortion. If eaten in large quantities it produces abortion in cattle. Ergot, I learn, has a strong smell and it commonly infects rye and less frequently wheat.

Now roe " rings " have been found in this country, in Germany and in Austria in " cornfields." Was that corn " rye " or if not " rye," was it wheat ? Most important of all was it infected in the vicinity of the rings with ergot—ergot just in that particular stage (the cockspur stage) which Mr. Ellis noticed on the purple moor grass I sent him from the roe rings in Argyllshire. One more point. There are no roe in the Himalaya or anywhere in India but there is a giant roe in the Thian Shan and in Manchuria and also roe in China proper. I am told that ergot is unknown in the Indian peninsula, but that it exists in China.

There used to be a theory (for all I know some people may still hold it), that roe have a second rut in October. Mr. John Anderson, the stalker who has watched the roe with me in Argyllshire, picked up both shed horns of our particular buck of 1948 and has generally kept a sharp watch on the roe, made a discovery in October that year which seems to me to show the reason for this theory and at the same time to refute it. Both at the " White Glen rings " and at the " Iron Stag rings " he saw, in the first week of October, the respective pairs of roe lying quietly in their rings. The " rings " themselves, however, showed no fresh tracks. It seemed to be just a peaceful visit to the scene of the honeymoon after the buck's solitary holiday in September, but perhaps there was some other mysterious purpose in it. Was the " ergot," at a later stage of its development, again some attraction and has it again some strange effect—not presumably the same effect as I suggest it may have in its earliest stage at the end of July and beginning of August, i.e. the effect of bringing on the rut.

I first began to watch roe in Epping Forest when I was ten years old, but it has taken me nearly sixty years to get my nose into the " rings "—perhaps the most mysterious subject connected with roe. The whole problem of roe and their " rings," the delayed development of the embryo and everything connected with it, needs a combined research by naturalists, by botanists and by doctors, both in this country and in others, in particular in Germany and Austria. Of this I am certain ; there is something in the " rings " in the last week of July and the first fortnight of August that constitutes an irresistible

The usual view of roe (November.)

Pair of roe in the rings (August.)

draw for roe to that particular spot. Is it " ergot " ? I think so. By careful investigation at a number of different " rings " it should be possible to prove whether " ergot " in a particular stage of development on some plant or other is always present at the rings at the moment when they are in use. Moreover, it may be possible to hand ergot in July to tame roe—a buck and a doe—and to withhold it from another doe and note the result. Lastly and more generally, is there some similar reason, not necessarily ergot, for the early mating and therefore for the delay in embryo-development in badgers, stoats, martens, black bears and armadillos ?

The verdict should be unproven, but capable of proof.

VI

OBSERVATIONS ON THE BITTERN AT THE NEST.

By R. P. Bagnall-Oakeley.

As I looked out over Cley marsh on the morning of March 1st this year (1949) it was blowing a gale from the north-east and the waves were breaking in the gardens of the cottages on the landward side of the coast road. Little did I think at that moment that there would be even the smallest chance of any bird nesting on the site of this scene of desolation in the breeding season that was shortly to follow. Yet within three three months I was sitting in a hide within 12 feet of a nesting bittern.

When the birds first started to boom after the floodwater had receded I was reminded of the translators of the Bible who refer to the bittern as the typical inhabitant of areas of desolation. The particular nest which I was fortunate enough to observe and photograph was one of two within a hundred yards or so of each other. It had been found by Bishop before all the eggs had been laid, and as soon as incubation started we began to erect a hide at some forty or fifty yards distant. To begin with it was only put up at half working height and was well camouflaged with reeds. Gradually it was moved up, until—at the end of a fortnight it was within twelve feet of the nest. The female bittern, who had watched the increasing proximity of the hide to her home with apparent unconcern, was by now almost inured to the approach of human intruders who often came to peer at her from behind this newly arrived erection. She was, in fact, the tamest of wild birds and an admirable photographic subject, since she seldom went far from the nest when disturbed before the start of a session of observation and photography. Indeed, for a few days immediately preceding the hatching of the eggs she would not even fly a short distance when disturbed, but merely stalked off the nest with dignified and unruffled demeanour to watch the elevation of the hide to operational height from a range of about ten yards! Twice when I put up the hide and got into

The female leaves as the nest is approached

Female rising from reeds.

it unassisted—an unusual performance by the normal rules of bird photography—she was back on to the nest before I was ready to begin taking pictures and she must have known that I was inside.

The nest was a remarkably small platform of reeds about 16 inches across and raised very little above the level of the damp ground. It was strikingly different from the substantial platform built over the water by the bird next door, though even this nest was small compared with the massive reed structures I have sometimes seen on the Broads.

Except on the occasions I have referred to above the method of approach of the bird to the nest was always the same. She would walk through the reeds, presumably in a crouching attitude until she was about six yards away, when she would stop and stand bolt upright with neck stretched and beak pointed upwards at about forty-five degrees. She would then slowly turn her head to and fro as if scanning the surroundings with great care. She might continue thus for fully five minutes after which time she would slowly crouch down and slink forward with her neck held horizontal, taking enormous and deliberate paces as if studying carefully where each foot should fall. She would pause for a further survey of the immediate vicinity at least twice more before slowly pushing her head through the reeds behind the nest to see if the coast was clear. Apparently it never was, as she always withdrew her neck at least once, before coming on to the nest. This she also did with huge deliberate paces, pausing between each and thereby presenting magnificent photographic opportunities. On one occasion when near the nest she suddenly stopped and from behind a screen of reed, which made it impossible to observe her, she gave a low muffled boom rather like a half-hearted bark from a deep-voiced dog. I heard this sound subsequently on one other occasion when she was a good deal further from the nest—perhaps ten yards or so distant.

Noises from inside the hide seldom worried her but the approach of a person always produced an immediate reaction. She would begin by "freezing" in a sitting position with her neck slightly stretched forwards and upwards and in this posture she would remain until a close approach to the nest seemed certain and imminent. She would then slowly stretch her head

and neck upwards finishing by being bolt upright, with her beak pointing skywards, though still resting on the tarsi. In this position the protective pattern and colouration of the plumage was quite remarkable and it would have been most improbable that any passer-by however close, would have spotted the bird, but for the exposed eggs. The ability of the bittern to observe any one who approaches from directly head-on is very noticeable from the close range of the photographic hide. The bird looks past its upturned beak on either side—a most uncomfortable looking operation—which gives one a feeling of eye strain when watching it.

The hatching of the three young—one egg was infertile—spread over six days and the discrepancy in size and state of development was apparent from the time the last one appeared. This disparity in size, nature and degree of mobility and the assumption of aggressive behaviour in self defence, became more and more apparent until the young were nearly three weeks old. Then a general levelling off in size, appearance and demeanour took place, but by this time the tendency to wander and the ability to hide made further observation difficult, although the young did not go far out of the nesting area. My first sight of these young bitterns—the youngest I had ever seen—reminded me of Miss E. L. Turner's description of the same experience when she likened the youngsters to "some uncanny prehistoric link between the reptile and the bird." To me the most outstanding feature of their grotesque make-up was not the curious blue green skin which shows so clearly through the warm brown fluff, nor yet the disproportionately large ungainly legs so frequently referred to by writers on this subject, but the extraordinary protruding eyes with their bulbous overhanging upper "lid." It is this feature, coupled with the massive beak and general fleshiness at the front of the head, which gives the reptilian impression.

I have already made reference to the discrepancy in size and rate of development. All the youngesters grew up at the same rate. Until three days old they supported themselves on the whole of the legs and scrambled about with astonishing mobility, greatly assisted by their metacarpal joints or "thumbs" on their wings. These were frequently used to support their bodies when something had alarmed them,

and they had assumed, even at this early age, the instinctive camouflage position. By the time they were five days old they could shuffle about on their tarsi, still making great use of their wings as a steadying factor, especially when they made excursions into the adjacent reeds. In a week they could stand, and by this time, too, their legs had developed to a remarkable degree in size and muscular growth. It was interesting to observe the three young birds just a week after the hatching of the first egg—the eldest strutting confidently about, number two shuffling happily around on his tarsi, while the smallest was scrambling energetically but clumsily about the nest platform on "all fours." By the time all were old enough to depart from the nest into the reeds in the intervals between being fed, these youngsters had learned to keep in touch by emitting a succession of curious subdued quacking noises not unlike a croaking of toads in the mating season.

The diet of this family was almost entirely fishy—largely eels—though on one occasion a flattenned frog and an unrecognisable small bird were regurgitated, though this latter item on the menu was pushed on one side by the female immediately after producing it as though she deemed it unfit for the young. She later ate it herself. Nothing is wasted of the food brought to the nest. What the young cannot or will not eat is cleaned up by the parent bird. The composition of the diet of these young bitterns was interesting since it showed that the range of fishing activities was at least a mile and probably more. No freshwater fish could have survived the invading salt water of early March, and so the frequent return of the parent bird with roach and stickleback showed that at the nearest she must have gone to the lower Glaven valley above Cley sluice. More probably she went to the higher and shallow reaches near Wiveton bridge.

The most interesting observations of all concern the appearance of the male bird at the nest. One afternoon when the youngest bittern was about five days old, I went into the hide, set up my camera and waited. Only one young one was visible on the edge of the nest, though occasional croaks indicated that the other two were not far off. After half an hour the parent bird was seen approaching at about ten yards range. At this distance it stopped for a further twenty

minutes frequently emitting warning "arrks" to the young. Gradually and very nervously it approached, stopping every two or three paces to stretch up and survey the scene. Not until nearly one and a half hours had elapsed did this bird eventually arrive on the nest and then only after peering tentatively through the reeds several times and making three false entries before staying in the nest platform. I was immediately struck by the bird's appearance being different from the usual that I had grown so accustomed to see, while the nervous demeanour had already set me wondering. The more I looked at this bird the more convinced I became that it was a different bittern from my usual quiet photogenic female, but not having expected to be called upon to make a comparison between the two birds, I could not decide precisely how they differed. After making a few exposures while the adult chucked to the young like a chicken calling her brood, I set myself to make a close scrutiny of the plumage and other characteristics of this bird. One thing I particularly noted was the curious graded colouring of the beak from base to tip and the light yellowish patch round the nostrils. The legs, too, seemed an unusually bright green.

This bird fed the young in the usual way, after they had stimulated regurgitation by seizing the beak and pulling it downwards. Only relatively small eels were produced, together with a copious flow of yellowish orange fluid which the young swallowed as it ran down the sides or dripped from the tip of the bill. At the end of the meal this adult bird withdrew and moved steadily right round the hide at a distance of about ten yards, finally disappearing almost completely behind the nest. Before disappearing, but when almost completely abscured he boomed three times in quick succession, during which I could see nothing but a slight quivering of feathers. What chiefly surprised me was the lack of volume and the quality of intense resonance in the boom. It seemed almost as if it had come from inside the hide.

Just as I was trying to summarize my impressions of the bird which had fed the young, he appreared again popping up after an unnoticed approach about five or six yards from the nest. He stretched up, looked round for a few moments and came nearer and then paused for another short survey. This

Male with chicks returning to his call.

Female and family just after hatching of last egg.

was more the usual form—and then I suddenly realized that this, too, was the usual bird—the female with whom I was so familiar. She took about quarter of an hour or so to come to the nest, and since the young were in no great hurry to excite her to feed them, I had time to look at her carefully and compare her all too familiar and therefore previously unobserved characteristics. Her beak was decidedly more evenly coloured with the lighter yellowish green line running down from the nostril towards the tip, broader and much less distinct. Her legs were darker and less vivid green and the black markings forming the stripes from the neck downwards across the breast were less intensely black and decidedly narrower. I also had the impression which I was never able to verify for certain—though the photographs support it to some extent—that the markings on the back of the male bird were darker and more clear cut.

The female stood over the young for some minutes until the largest decided it was time for another meal. He seized his parent's bill near the tip and since she failed to respond satisfactorily, he ran his grip right up the base of her bill while both the others got a hold of some kind lower down. There followed an extraordinary scene in which the adult bird worked her head up and down like a pump-handle compelling two of the youngsters to release their hold on it, but the third—the largest of the three—held on and was almost lifted off the ground at each up-stroke. I chanced my luck with some photographs which, considering the vigour of the operations, were likely to show movement. By choosing a fast exposure and developing by a new intensifying process I managed to obtain several interesting pictures. Two roach, a frog and three eels were regurgitated, but one of the eels being fully twelve inches in length was left by the youngsters and re-swallowed by the female after all feeding of the family had finished.

This bird soon left the nest and at a distance of about seven yards or so, performed her complete powder puffing operation, in which she did some remarkable contortions with her neck in the process of dispersing the powder through her feathers. On a subsequent occasion after arriving at the nest plastered with eel slime all round her cheeks and chin, I watched her

feed the young and then after cleaning up any unwanted or unnoticed pieces of food, retire to complete her toilet as before. After twenty minutes' neck-twisting and feather-fluffing and shaking, she moved back on to the nest platform. And then came one of those tragedies of bird photography—a perfect opportunity lost. I had completed my last exposure and had not bothered to reload the camera with a new film as all feeding seemed to have finished and I wanted a relatively slow film in the camera for landscape pictures on the way home. The female bittern now finished off her beauty treatment by oiling her feathers from which the slime had disappeared. She had arrived on the nest clear of slime but just as though she had been dulled in colour by a coating of dust and now she was "smartin' herself up" again. She pushed her head beneath her wing till her beak was somewhere under her tail and then, while looking like an enormous feather duster with two green handles, shook herself thoroughly. The spread of the oil over the neck feathers was accomplished by the same twisting contortions as before. She tapped her oil gland four or five times before being satisfied that her toilet was complete.

Only once again was the male observed at the nest, and then his approach and nervous entry to the nest platform was the same as before. But this time the young would not be called to the nest and he soon had to move to the reeds a yard or so from it to feed the young who had now become independent enough to make their parents come to them with their meals. Two other observers remarked on their impressions that both birds visited the nest—both without any suggestion on my part that this might be the case.

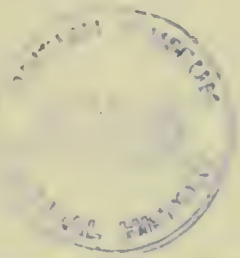
I was sorry to see the young bitterns grow up and wander away from the familiar nesting site, but I was at least happy to think that three more of our rarer breeding birds were growing up to swell the numbers of a species which in view of its former persecution, we are lucky to have with us at all.

EARLY MATING OF BITTERNS.

Report by G. Crees.

On the morning of January 5th, 1950 I was watching duck on Horsey Mere, when I was attracted by the sound of a bittern croaking. This bird flew very low over the water, and direct to a place on the south shore, where another bittern was standing. The two birds were clearly visible on the edge of some hover. To my great surprise the bird that had flown across the shore proceeded to tread the other bittern and I could see with my glasses that the behaviour was similar to that of a farmyard cock and hen.

After this incident the cock bittern flew away again for a distance of 200 yards; the hen watched him go, standing up and freezing. She afterwards slunk away out of sight. I never heard the hen call at all and did not see her until the cock arrived by her side. I imagine that she must have called to him since he flew direct to the place where she was standing. The wind was against me, which may have accounted for my failure to hear her. I have not heard a bittern boom this season and do not expect to do so at such an early date. I wonder if this is their normal procedure or whether this mating early in January is due to the mild weather.



MEMBERSHIP.

Candidates for ordinary membership may be nominated and elected at any meeting of the Society ; three dissentient votes shall exclude a candidate.

The annual subscription is ten shillings, payable on election or at the beginning of each financial year (April 1st) to the Hon. Treasurer, D. A. P. Gould, 8, Upper King Street, Norwich, who will supply a banker's order form for this purpose on request. Members may instead pay a life composition fee of £8.

Every member is entitled to receive one copy of the *Transactions* as published annually ; to attend the meetings and excursions and to make use of the Society's library. Members may bring friends to meetings.

Enquiries should be addressed to the Hon. Secretary, E. A. Ellis, Castle Museum, Norwich, to whom also applications should be made for back numbers of the *Transactions*.

MATERIAL FOR PUBLICATION.

The Hon. Editor will be glad to consider papers, preferably on Norfolk natural history, for the *Transactions*. These should aim at clarity of expression and should be typewritten. Such contributions should reach the editor by the end of September. The cost of a reasonable number of illustrations will be borne by the Society, but where great expense is likely to be incurred it is hoped that authors will endeavour to share the cost, by obtaining grants or otherwise. Authors receive 25 off-prints of their papers free and further copies may be ordered in advance either through the Hon. Secretary or the Soman-Wherry Press Ltd., Heigham Street, Norwich, from whom an estimate of the cost can be obtained.

CHANGE OF ADDRESS.

Prompt notification of members' changes of address will greatly facilitate the work of the officers of the Society.

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FOR THE YEAR

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NORFOLK AND NORWICH NATURALISTS' SOCIETY, 1949–50.

INCOME AND EXPENDITURE ACCOUNT for the year ended 31st March, 1950.

1949	Expenditure.	£ s. d.	£ s. d.	1949	Income.	£ s. d.
106	To Cost of Transactions		154 13 11	171	By Subscriptions :—Annual	190 12 11
	,, General Expenses.			16	Life	8 0 0
37	Postage, Printing and Stationery ...	33 18 1		4	,, Sale of Publications	1 7 6
6	Library Rent (2 years)	12 10 0		18	,, Interest and Dividends	30 4 8
15	Cost of Lectures	7 3 0				
5	Cost of Excursions					
3	Subscriptions to Scientific Societies	1 10 0				
6	Research Committee	5 0 0				
11	Sundries	3 15 4				
			65 16 5			
—	,, Depreciation of Office Equipment ...		9 14 9			
20	,, Excess of Income over Expenditure ...		— — —			
£209			£230 5 1	£209		£230 5 1

BALANCE SHEET as at 31st March, 1950.

1949	Liabilities.	£ s. d.	1949	Assets.	£ s. d.	£ s. d.
766	Amalgamated Funds, 31st March, 1949	766 4 1	15	Subscriptions due		1 0 0
26	Subscriptions in advance	40 0 0	723	Investments		723 5 5
96	Barclays Bank Account	151 5 5	150	East Anglian Trustee Savings Bank Account		205 12 8
			—	Office Equipment at cost	37 6 2	
				Less Depreciation	9 14 9	
						27 11 5
£888		£957 9 6	£888			£957 9 6

Audited and found correct,
H. W. BACK,
19th April, 1950.

I

HON. SECRETARY'S REPORT.

October 29th, 1949 : Mr. S. C. Porter lectured on " The Birds of Suffolk " with lantern slides. Fourteen new members were elected.

November 26th : Mr. S. Beaufoy gave an illustrated talk on " Some East Anglian Butterflies and Dragonflies." This was followed by a discussion in which many members took part. One new member was elected.

December 10th : Contributions to a symposium on some Norfolk mammals were made by Mr. R. P. Bagnall-Oakeley (on the badger), members of H.M. Forestry Commission (on roe deer) and Mr. E. A. Ellis, by proxy (on the coypu). Three new members were elected.

January 21st, 1950 : A lecture entitled " The life histories of the Heron and Bittern compared " was given by Messrs. R. Jones and R. P. Bagnall-Oakeley, the former describing the herons of Reedham and the latter the bitterns of Cley. One new member was elected.

February 18th : Major Anthony Buxton lectured on " Roe Deer and their Rings " and several members took part in the discussion which followed. One new member was elected.

March 18th : Dr. K. Carlson gave an account of his experiences with birds in Iceland, with lantern slide illustrations.

The 81st Annual Meeting was held at Norwich Castle Museum on April 22nd, 1950, when the President, Mr. James Fisher, M.A., F.L.S., delivered an address entitled " Bird Preservation." Officers for 1950–51 were elected as follows :—President, Mr. J. E. Sainty ; President-elect, Dr. Joyce Lambert ; Hon. Auditor, Mr. H. W. Back ; Hon. Treasurer, Mr. D. A. P. Gould ; Hon. Secretary, Mr. E. A. Ellis. Messrs. R. P. Bagnall-Oakeley, H. J. Howard and R. Jauralde were elected to serve on the Committee for three years. The Hon. Treasurer's statement for the year April 1st, 1949 to March 31st, 1950 was approved.

The Society is indebted to Mr. R. Jones and Miss Benn for the splendid way in which they conducted the meetings and made all arrangements throughout the year while the Hon. Secretary was unwell.

II

PRESIDENT'S ADDRESS

BIRD PRESERVATION.

Presidential Address delivered by James Fisher to the Members of the Norfolk and Norwich Naturalists' Society at Castle Museum, Norwich, on April 22nd, 1950.

In putting the subject before you to-day, I am aware that Norfolk is the home of nature protection, and bird preservation, and that Norfolk naturalists were interested in bird protection before the formation of the Royal Society for the Protection of Birds, of whose Education and General Purposes Committee I am Chairman; for the Breydon Society was started in 1888, and the R.S.P.B. not until the following year. We have had rather over sixty years of positive bird protection in this country, and with it has come a substantial change in people's attitude towards birds. My task to-day is to consider whether the active bird protection carried out during the present century has made a material difference to the variety and numbers of the British avifauna.

While it is probably true that the impoverishment of our birds in the nineteenth century owed much to the invention of the shot-gun, and to collectors and sportsmen and dealers and keepers, a lot of it was due to other causes, such as the draining of fens and marshes, and the cutting of woods, and maybe the spread of industry. Some birds probably became rare in the nineteenth century for causes which had nothing whatever to to do with man.

Nine species, at least, became totally extinct as nesters in Britain in the nineteenth century, though six of them have nested again in the twentieth century, of which two (bittern and avocet) have properly re-established themselves. Six of the nine are marsh-birds—Savi's warbler,* the bittern, the black-tailed godwit, the ruff, the avocet and the black tern; these probably disappeared primarily owing to the drainage of fens, and now that we maintain and preserve special marshes

*It is possible, though not absolutely proved, that the melodious warbler also bred in the nineteenth century.

for birds there is no reason why they should not come back, and there are many indications that they will. The other three met man the attacker ; the great auk was clubbed out of this world, the great bustard shot, the honey-buzzard shot or robbed.

To set against these losses, there were, during the nineteenth century, three introductions (capercaillie, red-legged partridge* and little owl) and four colonisations (gadwall, wigeon, pintail and goosander ; of which at least the gadwall was helped by introduction). Seven against nine ; a loss, though small in comparison with the other impoverishments. It is interesting to note that the gains in the nineteenth century were nearly all sporting birds.

Have we, in the twentieth century, regained the ground lost in the nineteenth ? This is the first half-century of organised bird protection, during which an enormous amount of time and quite a lot of money have been spent in preserving birds, and in educating the public to appreciate them, respect them, and leave them alone. Have the time and money been spent in vain ? Let us see what has happened to the 209 species that have been seen to have nested at least once on the British Isles in the period 1900 to 1949, by somebody who knew what it was that he saw.

The Predatory Birds.

The raven, crow, magpie, jay ; the eagles, falcons, hawks, harriers, buzzards ; the owls—the predatory birds of Britain, had a rough time at the beginning of the present century ; this was a hang-over from the previous century, in which they were shot on sight. But a change in human thought began to spread, and at about the time of the first World War most people began at least to realise that owls were mostly beneficial, and at most that predators had a distinction and beauty that warranted their restoration to something like their old place in nature.

The new thought was not in time to save the white-tailed eagle and the osprey, which joined the honey-buzzard and became extinct before that war. But the others recovered ;

*The nature and success of the eighteenth century introduction of this species in Suffolk is obscure (these *Transactions*, *5 :* 380).

the raven, carrion-crow, long-eared and tawny owls have increased continuously; so has the introduced little owl: and after a period in which the issue was in doubt no fewer than nine other predators have started to increase. The magpie and jay seem now to have defeated the keepers of Britain; before the first war the magpie was extinct in Norfolk, but since then there have never been enough keepers to keep it so. The barn-owl has recovered, though more slowly than the brown owl.

The peregrine, in spite of efforts by the Services during the last war to reduce it, is spreading to sites which have not been occupied for a hundred years. That lovely, swift falcon of the southern counties, the hobby, is building up its numbers after some persecution, in the last stages undoubtedly by egg-collectors. The merlin, the falcon of the moors, is also increasing. So, to everybody's delight, is the golden eagle, which has been breeding *outside* the Highlands of Scotland these last two years; how soon will it be back in Ireland, where it last nested about forty years ago? The buzzard, after much persecution, has spread since the first war into the Outer Hebrides, and back into parts of south-east England. In Orkney the hen-harrier is increasing under close protection, and it is re-establishing itself in parts of the Scottish Highlands.

Indeed, only three predators appear still to be decreasing. There is some evidence that the hooded crow's place in parts of the Highlands of Scotland is being taken by the carrion-crow; this is a change that cannot be shown to have anything to do with man. Though still common, the sparrow-hawk (upon which many keepers now concentrate almost exclusively) is probably slowly decreasing. The marsh-harrier is hanging on, but in very small numbers indeed. In some recent years there has been only one nest in Britain. This lovely species is in serious danger still, and its status as a British breeder hangs by a thread, in spite of the careful and close protection given it in Norfolk and Suffolk.

In the present century there has been so little change in the numbers of the kite that we cannot really record an increase or decrease. It has been apparently on the brink of doom for fifty years, but has never fallen in. From 1900 to 1949, in

Central Wales, the last stronghold of this once-common scavenger in Britain, there have never nested more than ten pairs of kites, nor less than three (as far as I know)—on an average about six. Yet in the last century the kite nested in every English county except one ; in most of Wales and the Highlands ; and in some of the counties in the Lowlands.

The shotgun—and the egg-collector and the trap—have created a problem which has been giving trouble to bird-protectionists for sixty years ; and while the kite hangs on, there is no sign of its spread into areas in which it once bred commonly. Maybe this will not be possible until keepers are even better informed about rare birds of prey, or until people stop using the illegal open gin rabbit trap, or until there is a little more carrion generally available.

Birds of Woodland and Man-Land.

Our profit and loss account for those birds which live in woods, parks, gardens, farms and towns is rather complicated. There are over eighty birds on the list, but for nearly half we have no evidence of change, or evidence that breeding has been fluctuating or sporadic. Sixteen species have noticeably decreased ; more than twice this number have increased. It is very difficult to decide why some species have decreased. Why are the corn-bunting and the yellow wagtail getting rarer, more local ? What is happening to our common redstarts and red-backed shrikes ? What *is* the reason for the disappearance of the wryneck ? Is it really modern farming technique that is driving the corncrake to the areas at the edge of Britain where husbandry is still fairly primitive ? Metalled roads, it has been suggested, may have deprived swallows and house-martins of mud for their nests ; certainly these birds are fewer than they were ; so are house-sparrows—is this because horses are fewer ?

Urbanisation, if it has reduced the numbers of some birds (I do not know of any whose numbers are reduced by *sub*-urbanisation), has given us a new one. Our only colonist in this group, in the twentieth century, is the black redstart, of which at least twenty-six and probably twenty-nine pairs nested in Britain in 1948 and twenty-eight or twenty-nine in 1949. This was first proved to breed in Britain at Pett Level

in Sussex in 1909. It nested there, and at other places, sporadically, for about thirty years. During the last war, however, this beautiful little bird ceased to be sporadic, and became established not only on the Sussex-Kent coast but in London, where bombed buildings provided it with the ruins and artificial cliffs in which it likes to nest.

Many of the gains in population by the birds of farmland in the present century appear to be due to the eclipse of the bird-catcher, and to the passing of laws making it illegal to offer wild birds for sale. Most people now prefer canaries and budgerigars as cage-pets to wild birds. Certainly goldfinch, redpoll and linnet have been increasing, much to everybody's delight.

The lapwing is a bird whose numbers appear to have been to a large extent controlled by man. Until Lord Buckmaster's Lapwings Bill received Royal Assent on 28 March 1928 this species had been steadily decreasing; its quick recovery as soon as it became illegal to sell its eggs was surely not coincidence, and during the thirties large flocks were common on all good farmland. During the second world war eggs began to be taken in numbers again, though it remained illegal to offer them for sale; and only very recently has the lapwing once more begun to recover. It seems to be very sensitive to egg-collection.

Some birds have undoubtedly increased because of the recovery of woodland, particularly in Scotland and Ireland; among them the greenfinch, siskin, bullfinch, several kinds of tit, spotted flycatcher, goldcrest, several kinds of warbler, and blackbird. In woodland, too, the nuthatch and mistle-thrush are spreading, as are the green and great spotted woodpeckers.

Birds of Mountain, Moor and Heath.

Of the twenty-one birds (apart from predators) which mainly nest on mountains, moors, heath and scrub, a rather surprising number appear to be decreasing, or to have been decreasing until recently. The twite appears to be withdrawing northwards, and to be becoming uncommon on the Pennines, its English headquarters. Ring-ouzel, wheatear, and stonechat are all decreasing, the last particularly. On some scrubs and heaths of the south the Dartford warbler still survives, but in

numbers which each hard winter seems further to reduce. It is still harried by egg-collectors.

Those moorland waders, the rare whimbrel and dotterel, and the dunlin and golden plover, have been in decline, though the curlew and greenshank have increased. On the brecks and chalk downs of a diminishing area of England the stone-curlew survives ; it loses a hill now and then, but never seems to gain one. But the grey wagtail, that handsome bird of mountain streams, is spreading. So, at last, is one of the rarest birds of coastal and inland cliffs, the Cornish chough. Once more there is a chance of seeing it in Snowdonia.

Birds of the Sea.

Changes in the numbers of sea birds have been many ; the spread of the fulmar overshadows them all. This albatross-like bird started spreading about 200 years ago in South Iceland, and has increased continuously. It became established in Britain in 1878. Now there are 155 fulmar colonies in Iceland and at least twenty-one in Faeroe. The Faeroe Islands were colonised early in the nineteenth century. There were in 1949, 577 known colonies in the British Isles, and they are still increasing at the rate of about thirty new colonies in Britain every year. At 365 of the 577 colonies the fulmars were actually breeding, at the rest " prospecting." The fulmar colonies are sometimes widely dispersed, and a colony has been regarded as such only when it is at least one mile from another. The fulmar has nested successfully in Norfolk since 1947, largely owing to protection. They have recently been seen possibly prospecting the " cliffs " at Minsmere in Suffolk, and at Broadstairs in the Isle of Thanet, at Hastings in Sussex, at the Needles off the Isle of Wight ; and certainly in Dorset. They have actually laid eggs now in South Devon, at eighteen places in Cornwall, in South Wales, nearly all round the coast of Ireland, round the Isle of Man, and nearly all round Scotland and northern England. In fact it is almost easier to name the cliffs which the fulmar has not yet colonised ! The reason for its intensive colonisation seems to be the availability of new and large supplies of food. The northern whaling industry, which started in the seventeenth century, continued through the eighteenth century; but in the nineteenth century it petered out and was largely replaced (from the fulmars' point of view)

by the trawling industry. The fulmars fed on the blubber and offal from the whales produced at flensing, and later, on the fish-guts disposed of by the trawlers; and it is a common sight to see several thousands of these birds following one trawler. This new supply of food was within operational range of their colonies, old and new.

The gannet has increased, and has started several new colonies in the present century. Gannets used to be eaten and used for bait by human beings; now they are spared, except at one colony north of the Hebrides, where they are still killed in some years. There have been great increases among the gulls (perhaps connected with the spread of fisheries) and among the terns (probably due to protection). The auks (the razorbill, guillemot, puffin) on the other hand, have decreased, though perhaps only in certain places. The eider-duck has spread, and another sea-duck, the scoter, started to breed regularly in Ireland and Northern Scotland during the present century.

Birds of Marsh and Fresh Water.

Of the fifty-four marsh-nesters and water-birds, no less than twenty-eight have increased in the present century. Six of these have arrived as colonists. Only five have noticeably decreased, of which only one has become extinct. This is the Kentish plover, really a shore bird, which used to breed in Sussex and Kent (it still breeds in the Channel Isles), but has not been *proved* to do so since 1931. Its nesting-grounds have been much disturbed by human activity, and egg-collectors may also have had something to do with its disappearance.

Birds of marsh-land which have decreased are the bearded tit, which, like the Dartford warbler, suffers from hard winters. After the last (1947) only one colony remained in all Britain, at Minsmere, in Suffolk. The recovery of the bearded tit can now be suspected to be aided by immigration. The rare spotted crake appears to be getting rarer still; nobody knows very much about it. On the Highland lochs the black-throated diver, and the grey-lag goose were slowly decreasing some years ago, though this decrease may now have stopped.

The revival of the water-birds is perhaps the most exciting thing that has happened, for the gains are quite remarkable, and entirely outweigh the losses. There has been a spectacular

increase of many species of ducks which has no doubt been assisted by sporting preservation, though its original cause is unknown, and an increase in, and recovery of, the numbers of marsh-birds which seems certainly due to better protection, for it has not been possible to restore much actual area of marsh.

One colonist (of the North of Scotland) in this century was the whooper swan—the wild swan—which had been extinct for well over a hundred years—since about 1788. During the nineteenth century Britain was colonised by the gadwall, wigeon, pintail and goosander, and these ducks have been increasing ever since, up to now, together with the sheld-duck, garganey, shoveler, pochard, tufted duck and red-breasted merganser. The twentieth century has brought us two new breeding grebes, the black-necked and Slavonian, both now well-established ; lovely creatures in the breeding-dress on English mere, Irish lough or Scottish loch.

In the nineteenth century the bittern's boom finally disappeared from the broads and marshes of Norfolk ; there was no suspicion of its breeding after 1886. But in 1911, thanks to Norfolk naturalists, it came back to Britain, and since then has spread to, and established itself in many marshes, in East Anglia, under close and careful protection.

On the lakes of England, ninety years ago, there were under forty nests of great crested grebes ; the protectionists of those early days, with sympathetic landowners, fought the killers for the plume-trade, saved this lovely bird, and laid the foundations of its present population—there were about 1,240 nests in England, Wales and Scotland in 1931, and have probably been more since.

Up to 1938 a handsome creature, the little ringed plover, which nested in France, Belgium and Holland, was a rare vagrant to Britain. But in that year a pair was found nesting on the shore of a half-empty reservoir at Tring, in Hertfordshire. Since then a population of little ringed plovers has colonised gravel pits and the like, in increasing numbers yearly, in and beyond the Home Counties. The latest news is that in 1948 sixteen pairs spent the summer within twenty miles of St. Paul's Cathedral, while two pairs bred at Tring, three in Suffolk, one in the West Riding of Yorkshire ; and birds were seen also in Sussex, Surrey and Buckinghamshire. Another new British breeding bird.

I leave the greatest triumph until the last. In 1843 some avocets probably bred in Kent ; if they succeeded (which is not certain) they were the last for nearly a hundred years. In 1938, on the coast of Ireland, two pairs, surprisingly, nested within a few yards of each other. Nothing more happened ; they did not come again. Then, during the summer of 1947, two small colonies nested in East Anglia. In 1948 they nested again at one of the sites. From at least eleven nests thirteen young safely flew. In 1949 the colony was larger, and the output greater : and in 1950 I spent some happy hours watching them, in even greater strength, on what is now an inviolable sanctuary ; for the Royal Society for the Protection of Birds has purchased the island on which they nest, and we are now allowed to say that it is Havergate Island, on the Suffolk coast, near Orford. The Society has spent a very large sum of money on making the lagoons just right for the avocets ; with a new sea-wall and sluices they can adjust the water-level to within an inch. The avocets have established what is now more than a mere outpost of their well-known colonies in Holland.

The Next Fifty Years.

What of the next fifty years ? Are we to have any more new British breeding birds ? The answer is certainly yes ; though it is not easy to choose a short list of the possible candidates. These include the following birds which, amongst others I cannot mention, have already nested in the British Isles in the present century and may become regular instead of sporadic :—

Golden oriole
Brambling
Tawny pipit
Moustached warbler
Icterine warbler
Redwing
Bee-eater
Hoopoe
Honey-buzzard
Little bittern
Red-crested pochard
Scaup
Goldeneye
Long-tailed duck
Black-tailed godwit
Temminck's stint
Ruff
Green sandpiper
Black-winged stilt
Black tern

There are at least three more possible invaders, which are spreading west in Europe and may well reach Britain before 2000. There are the little gull, the serin (which is the wild form of the canary) and the collared dove. The collared dove has not yet been even *seen* in Britain, but I expect that it will come, judging from its present rate of spread. If any of these birds do establish themselves, there is no doubt that they will get an enthusiastic and helpful reception.

There seems to be a progressive amelioration of the climate of western Europe, which might appear to favour the candidates from the south, rather than those sporadic breeders which have in past years appeared to seek admission from the north (redwing, brambling, scaup, goldeneye, long-tailed duck, Temminck's stint, green sandpiper). I think it improbable that the great northern diver and turnstone, which hang about the northern isles in some numbers nearly every summer, will be proved to breed. But my money is firmly on the golden oriole, hoopoe, black-tailed godwit and ruff, and I do not regard the black tern, tawny pipit or red-crested pochard as outsiders.

Incidentally, the invasion from the south is even more well-marked in Iceland, for its breeding birds have increased from sixty-six to seventy-three in the present century, that is, by just over 10 per cent. Iceland has lost none, and gained seven ; though, with the northward retreating sea-ice, it is in danger of losing the little auk, which is reduced (as far as is known) to a score or so birds at their ancient breeding-place on Grîmsey, the little Iceland island that cuts the Arctic circle.

It is clear that many changes that have taken place are due to nature, or to a mixture of nature and man, or only indirectly to man. And—irrespective of their origin—there are some changes which man seems powerless, or almost powerless, to influence. Nevertheless, what I have written in this article is surely proof that for the first time in history man has been able, to a certain extent, by protection and care, to direct the composition of his native bird fauna, and improve it. In the last fifty years, in spite of numerous mistakes and no doubt a lot of muddling, we have regained lost ground. We can say now that we in Britain have a greater population and variety of wild birds to enjoy than at any previous time of our history.

THE BIRDS THAT BREED IN BRITAIN.

Statement of account for the half-century ending 31*st December,* 1949

INCOME AND EXPENDITURE ACCOUNT.

Expenditure.		Income.	
Extinctions during nineteenth century	9	Introductions during nineteenth century	3
Extinctions during half twentieth century ...	3	Colonisations during nineteenth century	4
Balance—excess of income over expenditure*... ...	3	Colonisations during half twentieth century ...	8
	15		15

(*for last half-century : 5)

GENERAL ACCOUNT.

Losses by extinction ...	3	Gains by colonisation ...	8
Noticeably decreased ...	41	Noticeably increased ...	72
Profit : extra enjoyment for bird-watchers	51	Decrease followed by increase	15
	95		95

ESTIMATES FOR SECOND HALF TWENTIETH CENTURY.

Extinctions, as suggested by pessimists	2	Colonisations, not suggested by optimists	8

DEFERRED UNTIL NEXT MEETING (31 DECEMBER, 1999).

No evidence of change	43
Markedly fluctuating	6
Sporadic	21
	70

SUMMARY : THE NUMBER OF DIFFERENT KINDS OF WILD BIRDS THAT UNDOUBTEDLY NESTED IN THE BRITISH ISLES IN THE YEARS 1900—1949 INCLUSIVE.

Decreased or extinct	44
Increased or colonised	95
Static, fluctuating and sporadic	70
	209

I certify that the above gives a true account of the National Bird Balance Sheet, to the best of my knowledge and belief, and in the light of the documents and explanations furnished, amongst others by E. M. Nicholson (*Birds in England*, 1926), by H. F. Witherby and others (*Handbook of British Birds*, 1938—41), by W. B. Alexander and David Lack (*British Birds*, vol. 38 : 41—45, 62—69, 82—88, 1944), and by some researches of my own.

January, 1950. JAMES FISHER.

REFERENCES.

ALEXANDER, W. B. and LACK, David (1944). "Changes in Status among British Breeding Birds." *British Birds, 38 :* 42—45, 62—69, 82—88.

FISHER, James (1950). "British Birds since 1900. A Profit and Loss Account of our Breeding Species." *Leader* for 7 January : 14—16, 38.

INGRAM, Collingwood (1950). "Changes in the Population of British Birds." *Country Life, 107 :* 1196—98.

NICHOLSON, E. M. (1926). "Birds in England." London, Chapman and Hall.

WITHERBY, H. F. and others (1938—41). "The Handbook of British Birds." London, Witherby.

This article, and the analysis that follows, is based partly on the substantial foundation provided by Alexander and Lack, quoted above. Events of the last six years have enabled me to take their analysis a little further, and I have grouped the birds somewhat differently. Ingram's article, written independently of mine in the *Leader* (upon which this more detailed paper is based), comes to almost exactly the same conclusions about some of our changing bird populations.

APPENDIX.

A classification of the British breeding birds, by population-trends, 1900—1949 inclusive.

PREDATORY BIRDS (24)

Noticeable increase (5) : raven, carrion-crow, little owl, long-eared owl, tawny owl.

Decrease, followed by increase (9) : magpie, jay, barn-owl, peregrine, hobby, merlin, golden eagle, buzzard, hen-harrier.

*No evidence of change** (3) : kestrel, Montagu's harrier, kite.

Sporadic (2) : [Supressed for security reasons].

Noticeable decrease (3) : hooded crow, marsh-harrier, sparrow-hawk.

Extinction (2) : white-tailed eagle, osprey.

BIRDS OF WOODLAND, FARMLAND AND TOWN (83)

Colonisation (1) : black redstart.

Noticeable increase (32) : rook, jackdaw, starling, hawfinch, greenfinch, goldfinch, siskin, redpoll, linnet, bullfinch, crossbill, chaffinch, nuthatch, great tit, blue tit, coal-tit, spotted flycatcher, pied flycatcher, goldcrest, willow-warbler, wood-warbler, blackcap, whitethroat, lesser whitethroat, mistle-thrush, blackbird, green woodpecker, great spotted woodpecker, stock-dove, black-headed gull, capercaillie.

*Excepting, of course, some local change.

Decrease, followed by increase (2) : lapwing, partridge.
*No evidence of change** (21) : yellowhammer, cirl bunting, skylark, tree-pipit, tree-creeper, marsh-tit, willow-tit, chiffchaff, grasshopper-warbler, garden-warbler, song-thrush, nightingale, robin, hedge-sparrow, wren, nightjar, lesser spotted woodpecker, cuckoo, turtle-dove, pheasant, red-legged partridge.
Evidence of fluctuation (4) : tree-sparrow, crested tit long-tailed tit woodcock.
Sporadic (7) : golden oriole, brambling, tawny pipit, icterine warbler, redwing, bee-eater, hoopoe.
Noticeable decrease (16) : corn-bunting, house-sparrow, wood-lark, yellow wagtail, pied wagtail, red-backed shrike, redstart, swallow, house-martin, sand-martin, wryneck, wood-pigeon, rock-dove, corn-crake, black grouse, quail.

BIRDS OF MOUNTAIN, MOOR AND HEATH (21)

Noticeable increase (3) : grey wagtail, curlew, greenshank.
Decrease, followed by increase (1) : chough.
*No evidence of change** (3) : meadow-pipit, rock-pipit, whinchat.
Evidence of fluctuation (2) : snow-bunting, short-eared owl.
Noticeable decrease (12) : twite, Dartford warbler, ring-ouzel, wheatear, stonechat, whimbrel, dunlin, golden plover, dotterel, stone-curlew, red grouse, ptarmigan.

BIRDS OF MARSH AND FRESH WATER (54)

Colonisation (6) : bittern, whooper swan, Slavonian grebe, black-necked grebe, little ringed plover, avocet.
Noticeable increase (20) : sedge-warbler, kingfisher, mute swan, Canada goose, sheld-duck, gadwall, garganey, wigeon, pintail, shoveler, pochard, tufted duck, goosander, red-breasted merganser, greatcrested grebe, snipe, redshank, oyster-catcher, moorhen, coot.
Decrease, followed by increase (2) : red-throated diver, red-necked phalarope.
*No evidence of change** (11) : reed-bunting, reed-warbler, marsh-warbler, dipper, heron, mallard, teal, little grebe, common sandpiper, ringed plover, water-rail.
Sporadic (10) : moustached warbler, little bittern, red-crested pochard, scaup, goldeneye, black-tailed godwit, Temminck's stint, ruff, green sandpiper, black-winged stilt.
Noticeable decrease (4) : bearded tit, grey lag-goose, black-throated diver, spotted crake.
Extinction (1) : Kentish plover.

SEA-BIRDS (27)

Colonisation (1) : scoter.
Noticeable increase (12) : eider, gannet, fulmar, Sandwich tern, roseate tern, common tern, common gull, herring-gull, lesser black-backed gull, great black-backed gull, kittiwake, arctic skua.
Decrease, followed by increase (1) : great skua.
*No evidence of change** (5) : cormorant, shag, storm-petrel, Leach's fork-tailed petrel, arctic tern.
Sporadic (2) : long-tailed duck, black tern.
Noticeable decrease (6) : Manx shearwater, little tern, razorbill, guillemot, black guillemot, puffin.

*Excepting, of course, some local change.

III

THE INTRODUCTION OF THE LARGE COPPER BUTTERFLY, *Lycaena dispar batavus* (Oberthür), AT WHEATFEN BROAD, NORFOLK.

By E. A. Ellis.

The exclusively British race of the Large Copper, *Lycaena dispar* (Haworth) inhabited the fens of Huntingdonshire, Cambridgeshire, Norfolk (Bardolph Fen) and Suffolk (Benacre) and became extinct round about the year 1851. Its disappearance followed the draining, mowing and burning operations carried out in its native haunts and, in the last stage, when it had become very localised, intensive collecting by and for entomologists.

The smaller and less brilliant race, *L. dispar rutilus* (Werneberg), inhabiting a large part of Europe and extending into western Asia, was introduced unsuccessfully at Wicken Fen, Cambs., by G. H. Verrall, in 1909. In 1914, however, E. B. Purefoy succeeded in establishing a colony in Tipperary, Ireland, and in 1926, under the auspices of the Committee for the Protection of British Insects, more than 500 butterflies of Captain Purefoy's Irish stock were released at Woodbastwick, Norfolk, in the hope that they would settle down and multiply in what appeared to be suitable terrain bordering the Broads. This experiment failed, mainly, it is thought, because the food plants (Great Water Dock, *Rumex hydrolapathum* L.) were growing chiefly alongside the waterways, and not dotted about the marshes suitably for the needs of the butterfly in its early stages of development.

In 1915 another race of the Large Copper was discovered in Friesland. At first it was thought to be a relict colony of butterflies identical with the lost British form, which it resembled in points of size and brilliance. Small but sufficiently constant differences in marking, however, led entomologists to decide that it was worthy of separate racial rank, and it is now known as *L. dispar batavus* (Oberthür). This magnificent insect appeared to be in peril of early extinction in Friesland soon after its discovery, and for this reason an attempt was made in

Photograph by S. Beaufoy

LARGE COPPER (*Lycaena dispar batavus*)
Male (slightly enlarged)

1927 to establish a colony of *batavus* in a former haunt of the old British *dispar* in Britain. With the collaboration of Dutch entomologists, Captain Purefoy organised the experiment on behalf of the Committee for the Protection of British Insects, with the result that the Large Copper came to flourish at Wood Walton Fen, Huntingdonshire, where it still exists.

In 1930, after adequate provision had been made for a supply of water docks, the butterfly was introduced at Wicken Fen, Cambridgeshire. There it became established reasonably well and continued to exist until the portion of the Nature Reserve most suited to its needs was given up to agriculture during the second World War.

In 1948 the Insect Protection Committee considered that in view of difficulties tending to arise through intensive drainage in the Wood Walton area, it was desirable to make some effort to found an outlying colony of the Large Copper in the Norfolk Broads. The situation was affected also by the fact that there had been no news to encourage the belief that the butterfly had survived the War in Holland.

After due consideration, the Committee arranged that I should visit Wood Walton Fen with Captain N. D. Riley, Honorary Secretary of the Royal Entomological Society of London, on 23rd May, 1949, to inspect conditions there, and learn essential details of the ecological requirements of the butterfly in all its stages of development. After receiving a great deal of helpful information from Mr. George Mason, the Keeper of the Fen, and seeing how the caterpillars were distributed on water docks growing under various conditions, I was furnished with two dozen larvae for the initial experiment of putting them down at Wheatfen Broad in Norfolk.

All the larvae survived transport, and after being fed on leaves of water dock freshly supplied every day in a small cage, they were transferred on 29th May to a large dock plant growing on Home Marsh, Wheatfen, and protected from the attentions of any possible enemies by a large muslin-covered frame. The first larva pupated on 31st May. The first butterfly, a male, emerged on 26th June ; three males and one female came out on the following day, and the rest followed at intervals during the next three weeks. On 6th July, 36 pupae were received from

Captain E. B. Purefoy and affixed to sedge leaves in the cage on the marsh, and on 15th July a further batch of 21 pupae was similarly dealt with. Between 26th June and 29th July, eighty butterflies were released on the Fen ; of these, 34 were males and 46 females. The first eggs were found on a fairly young dock on Home Marsh on 9th July, and caterpillars emerged from these on 23rd July. Eggs were laid on some hundreds of docks on the Fen, and by 5th August there were numbers of larvae, chiefly close to the centre of dispersal ; a few were found at No. 1 Brickyard, Surlingham, rather more than half a mile away. Almost every day from late June to the end of July was warm and sunny, and favoured the butterflies' activities. Then came a spell of wet and very windy weather from 30th July to 2nd August, after which no Large Coppers were seen on the wing. In view of this sudden disappearance it is interesting to record that one of the butterflies was seen on 5th August by Mrs. C. Smith at Ellingham, in the Waveney valley, nine miles south-east of Wheatfen.

Experience in other areas had shown that the habitats most suited to the butterfly's needs were those in which the Great Water Dock grew in clumps scattered over fenland in company with sedges, rushes and an abundance of plants such as Meadow Rue (*Thalictrum flavum*), Valerian (*Valeriana officinalis*), Purple Loosestrife (*Lythrum salicaria*), Tufted Vetch (*Vicia cracca*) and Marsh Thistle (*Cirsium palustre*) attractive to the adult insects. These conditions were fulfilled amply at Wheatfen and the Large Coppers were seen to visit flowers of all the plants listed above and in addition, those of Marsh Bird's-foot Trefoil (*Lotus uliginosus*), Knapweed (*Centaurea nemoralis*) and Common Hawkbit (*Leontodon hispidus*).

The young larvae went into hibernation in brown, curled up leaves of the water docks during the latter part of August and early September, and so remained for the winter. The winter proved mild and dry on the whole, and there were no lasting floods on the marshes. The docks at Wheatfen are seldom covered by water for more than a few hours at a time when spring tides occur, and conditions in this respect differ greatly from those obtaining at Wood Walton, where the hibernating larvae are often under water for several weeks on end.

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Photograph by S. Beaufoy

LARGE COPPER (*L. dispar batavus*)
Female (slightly enlarged)

In March, 1950, about a hundred seedling water docks were planted to supplement those growing naturally on the Home Marsh, so as to give the nucleus of the butterfly colony a little extra encouragement at the central dispersal point.

The first awakened larva was discovered feeding on a young dock leaf on 5th April. By this time most of the docks were beginning to sprout ; those growing in the rushy part of the marsh at the highest level were nibbled by rabbits, but those in the wetter portion were undamaged, and they were in the majority. On 11th May it was estimated that about 20 per cent of the water docks on Home Marsh were inhabited by caterpillars of the Large Copper ; on this date a dozen of the larvae were transferred to living docks under a muslin-covered frame for protection against possible attacks from parasitic flies. Larvae were found in other parts of the Fen, up to half a mile from the marsh on which the butterflies had been released. It was disappointing to find that in only two instances had caterpillars wintered successfully on the very large docks growing in *Glyceria maxima* swamps. The best areas proved to be those supporting a fairly tall, mixed marsh vegetation including sedges, yellow and purple loosestrife, meadowsweet, hemp agrimony, etc.

Nine more larvae were placed in the cage by 2nd June, and all the caged specimens pupated successfully. The first butterfly, a very large male, emerged and was released on 2nd July, when flowers of Valerian and Meadow Rue were plentiful. Thirty-six pupae were received from Capt. Purefoy on 6th July. The butterflies continued to emerge during the following fortnight in increasing numbers, both from the cage and in the open. The first eggs were seen on 12th July. On 13th July, a hot sunny day, there was a good sprinkling of the butterflies on Home Marsh, and in the early evening Mr. A. C. Warren photographed a pair in cop. and others singly after stalking them with a small camera. We estimated that about 60 butterflies emerged naturally in the open at Wheatfen in the course of the season, apart from those released from the cage.

On 23rd July, seventeen unhatched pupae were transferred to Wood Walton Fen ; one female emerged on the journey and was released on arrival. This was done because the stock at Wood Walton had suffered severely as the result of flooding in

April, 1950, and only a very few female coppers had survived in proportion to the males. Unfortunately, most of the pupae taken from Wheatfen proved to be dead, and when opened in August, a fungus (*Cephalosporium* sp.) was found on them. I am of the opinion that the death of the pupae was due to trying conditions which beset them a few days before they were moved. It happened that one evening they were soaked by a torrent of rain (almost a cloudburst) while in the cage at Wheatfen and on the following morning very strong sunshine rendered the interior of the cage exceptionally hot and steamy. In this humid atmosphere the pupae may have become susceptible to infection by *Cephalosporium*, several species of which are found on moribund and dead insects and spiders in damp habitats.

Mr. G. Mason, the Keeper of Wood Walton Fen, spent a week at Wheatfen in early August, and expressed himself well pleased by the conditions obtaining there. He saw large numbers of eggs on several of the marshes, and considered that the natural abundance of water docks in places suited in other respects also to the needs of the Large Copper was a feature that promised well for the experiment.

It is estimated that more larvae were produced on the Fen in 1950 than in the previous year. It remains to be seen whether a wet autumn and winter following will have reduced their chances of survival.

It has been found in other breeding grounds that the Large Copper caterpillars are parasitised rather freely in some years by the Tachinid fly, *Phryxe vulgaris* (Fallén) ; so far, this insect has not come to notice at Wheatfen, and no parasitised larvae have been found there. Captain Purefoy has pointed out elsewhere that the pupae turn black, and become very conspicuous on the food plant just before the butterflies are due to emerge, so that they run a considerable risk of being pecked off at that time by birds. The butterflies themselves have hitherto been thought to have no enemies ; but in July, 1949, whitethroats which had a nest at the edge of Home Marsh, Wheatfen, acquired the habit of catching and eating the bodies of female Large Coppers. The birds were seen to swoop at the butterflies on several occasions, usually in the evening, and three sets of

Photograph by S. Beaufoy

LARGE COPPER (*L. dispar batavus*)
Female, underside (× 2 diameters)

bitten-off wings were found on a path running through the marsh. At the end of July there was an influx of migratory Large White butterflies (*Pieris brassicae* L.) on the fen, and these also were caught and their bodies eaten by the whitethroats. The birds returned to nest in the neighbourhood in 1950, but though they were seen in pursuit of the coppers on a few occasions, no detached wings of the insects were found. Sedge warblers appeared to take no interest in the butterflies. Large dragonflies, *Aeshna grandis* (L.) were often seen patrolling the fen when the coppers were on the wing, but they did not stoop at the butterflies.

In conclusion I should like to acknowledge the spirited assistance of Captain E. B. Purefoy throughout the period in which the experiment has been conducted. But for his initiative and continued enthusiasm it is highly probable that *Lycaena dispar batavus* would by now have become as extinct as the glorious *dispar* of Old England.

REFERENCES

Entomological Society of London, 1929, Report of the Committee appointed for the Protection of British Lepidoptera, *Proc. Ent. Soc. Lond.* 4 : 53–68, pl. 2.

Gurney, G. H., 1927. Introduction of the Large Copper Butterfly, *Chrysophanus rutilus*, in Norfolk, *Trans. Norf. & Norw. Nat. Soc.* 12 : 262–3.

Gurney, G. H., 1928. The Large Copper Butterfly (*Chrysophanus rutilus*), *Trans. Norf. & Norw. Nat. Soc.* 12 ; 379.

Purefoy, E. B., 1931. *Chrysophanus dispar batavus* Oberth. in Wicken Fen ; the romance of a beautiful and very rare butterfly, *Entomologist* 64, Dec. 1931.

IV

WILD BIRD PROTECTION IN NORFOLK IN 1950

Report of the Council

The Council has much pleasure in presenting its annual report on the bird life of the Norfolk nature reserves, with miscellaneous ornithological notes from other parts of the County.

It acknowledges with gratitude the assistance of so many supporters who with donations and subscriptions help to maintain the Trust's properties on the coast, in the broads area and in breckland.

The Council is also indebted to Mr. Walter Higham and Mr. R. P. Bagnall-Oakeley for their beautiful photographs which illustrate the report.

Mr. R. A. Richardson's account of the year's work at the Cley Observatory is of great interest and serves to prove its scientific value as one of four such stations in the British Isles.

Visitors to Cley, so many of whom frequent the East Bank for bird-watching will be pleased to know that repairs to the five large breaches made by the sea-inundation of early 1949 have recently been completed. The bank is a well-known feature of the marshes and affords such a fine view over those of both Cley and Salthouse that, apart from its value as a sea defence, the large expenditure involved is felt to have been worth while.

It is with deep regret that members will have learned of the death in October of Charles Chestney, Warden of the National Trust property of Scolt Head island for twenty-five years; and of that of his wife killed instantly in a tragic accident six weeks earlier.

Chestney's love of the Island and of his work there was apparent to all who visited it, and this was the secret of his success as a warden. During his illness he dwelt much upon his happy life, and it is as a man of strong character whose work was his pleasure that his friends will remember him.

CHARLES CHESTNEY.

The appointment as Warden of Robert Chestney, who has been familiar with the island all his life and who did much to help his father, will give widespread satisfaction to all who know him.

SCOLT HEAD ISLAND.

The following records are taken from the diary of the late Charles Chestney and, during the latter part of the year, of his son Robert.

The winter on the whole was mild with intermittent cold spells none of which were of long duration. A little light snow fell at the end of January and beginning of February and during this time there were two marked immigrations of fieldfares, redwings and blackbirds, one on January 28th and the other on February 2nd. March was a fine warm month and as so often happens during an early warm spell there were signs of breeding activity among the ringed plovers and oyster-catchers.

The following notes are of birds seen during the winter months :—

Brent Goose.—A few were in the harbour from January 12th until March 22nd, but at no time were there over fifty birds. On April 1st there were fresh arrivals and a party of twenty-two were seen flying in from the sea. These gradually dwindled in number until only four were left on April 25th. Two which remained until May 13th were probably pricked birds.

Pink-footed Goose.—Very few grey geese used the neighbouring marshes or were seen passing over to feed on the uplands. One skein of forty flew in from the sea towards Holkham on February 24th, but were not seen to settle.

Goldeneye.—Nine were in the harbour on February 11th and three were seen there on March 12th.

Pintail.—Four, with a party of wigeon, were in the harbour on January 16th, the first seen for a considerable time.

Long-tailed Duck.—A female seen in the harbour on March 22nd, and a pair in full summer dress remained from May 13th to 17th.

Smew.—Two birds, one a fine white male, were in the harbour on March 10th. Two more believed to be a pair, were seen offshore on April 17th.

Woodcock.—A single bird flushed from the Long Hills on April 25th, flew straight out to sea, and was lost from sight.

Little Gull.—Two birds believed to be of this species were resting on the sand close to the sea on February 25th. They flew off as they were approached looking very white in the winter sun.

Little Auk.—One seen flying near the shore on February 25th.

Great Northern Diver.—Two in the harbour on January 12th and four offshore on February 4th.

Black-throated Diver.—One in the harbour on January 21st and two offshore on February 4th.

Water-Rail.—These birds always remain at the Overy end of the island during the winter months. Two were flushed from the suaeda bushes there on January 14th and three on January 21st.

Snow-bunting.—Flocks frequented the island from the end of October 1949 until April. An estimated number of birds of the largest flocks was 150 and these diminished gradually until only a few remained on April 25th.

Shore-lark.—Small parties first noted on October 24th 1949, remained throughout the winter. The largest number seen was on February 27th when thirty birds were counted in two groups of nineteen and eleven. The last date on which they were seen was on April 21st when five were on Long Hills beach.

Green Woodpecker.—A bird flushed from House Hills on March 25th, flew out to sea and disappeared from sight.

Kingfisher.—A single bird was seen from the Overy bank on March 8th and two near the sluice on March 13th, probably the pair which nests nearby.

Short-eared owl.—Nine were flushed from the marram by the Warden's dog on January 11th and presented a lovely sight flying off together.

Hen-harrier.—Single birds were frequently seen flying over the dunes and salt-marshes.

Buzzard.—On January 23rd a buzzard, probably a rough-legged, was seen flying eastward over the Brancaster golf

course mobbed by numbers of smaller birds. It made off towards the Holkham woods.

White-tailed Eagle.—An immature sea eagle was seen flying a mile offshore on January 7th. This was undoubtedly the bird which spent the winter of 1949—50 on the coast between Brancaster and Cley, making Blakeney Point its headquarters.

Merlin.—On January 26th a merlin was seen to take a sanderling from a flock on the shore, carry it a short distance and alight to eat it. On February 22nd one was watched harrying a flock of starlings, but each time it tried to make a kill the birds foiled it by packing close together. Later it transferred its attention to the snow-buntings and this time was successful in killing its prey.

Breeding Species.

Following a fine March, April proved very cold with high winds sometimes reaching gale force, and the summer generally was cool and wet.

The breeding season for the terns on the island was disappointing. Sandwich terns arrived in parties from the middle of April to June, but never settled down. Common and little terns were also fewer than usual. Food was scarce at the beginning of the season, and later, in June, the Warden was much troubled by rats which having found the ternery were very difficult to kill in the dune-area. Other species had a good season and more than the average number of redshanks' nests were found.

Sandwich Tern.—The first arrivals were in the harbour on April 7th. On May 4th fifty pairs began to nest on the ternery but did not stay. At this time food was very scarce inshore. The first egg was found on May 20th but after laying a few eggs these birds also left. Finally only four pairs remained to breed. The first chicks hatched on June 24th.

Common Tern.—The first birds arrived on April 22nd, scrapes were made on May 12th and twenty-four eggs were counted on May 25th. Another lot of birds began nesting on the shingle ridges on June 19th. Eggs were still being laid on July 15th and some chicks were hatched on the 19th. The final count was 450 nests.

Little Tern.—First arrivals were in the harbour on April 22nd. A total of seventy-two nests was counted well spread out down the beach from the ternery to Smugglers Gap.

Ringed Plover.—Preliminary breeding activity was noticed on March 9th in warm still weather, but the first nest with eggs was found nearly a month later on April 7th. The first chicks were seen on April 14th. Thirty nests were found but there was a higher mortality than usual among the chicks caused by the cold wet weather, and in a number of cases parent birds were seen with only one chick.

Redshank.—Nineteen nests were found, rather more than the average number. Besides those on the dune areas a nest was found on Butchers Beach on May 5th and another on the same date near the Hut.

Oyster-Catcher.—It was estimated that about the usual number of pairs bred although the nests were not counted. They were back at their nesting sites on May 1st and the first eggs were noted on the 12th.

Black-headed Gull.—These nested in considerable numbers on the higher parts of the salt-marshes and did not suffer loss by being washed out by high tides as so often happens.

Sheld-duck.—A number were looking for nesting holes in the dunes on March 9th. By the 30th pairs were obvious all along the island and it was thought that there were more than the average number breeding. Large parties of young were in the creeks on June 23rd and at this time the Warden saw a brood of nine being brought down by the parent bird to the saltings from the common above the village.

Mallard.—Three nests were found, an early one with one egg on March 9th, another with ten eggs on March 30th, and a third on the ternery, the chicks of which hatched on May 12th.

Short-eared Owl.—No nest was found, although a pair frequented the island throughout the summer and must have bred nearby.

Wheatear.—A nest with five young was found near the Hut on June 28th.

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Sandwich Terns, Blakeney Point.

The weather conditions appear to have had no adverse affect on the nesting of linnets, or meadow pipits, which were as numerous as usual.

The return of winter resident birds was heralded by the arrival of twenty-two wigeon which were in Norton creek on August 7th. On September 16th large numbers were resting on the sea.

A purple sandpiper on the Beach Point on September 5th was so tired that it allowed R. Chestney and a visitor to approach within four yards.

The first snow-buntings, a party of sixteen, and five shore-larks arrived on the ternery beach on October 5th.

On October 9th a skein of grey geese was seen flying offshore in a westerly direction. A barnacle goose, resting on the ternery point on October 16th, flew off as it was approached.

An immigration of robins, blackbirds, thrushes, fieldfares and goldcrests took place on October 24th. A single woodcock was also seen on that date.

A red-breasted snipe first seen on October 29th, and which remained on the marsh opposite the Hut for several days, was identified by Mr. David Jenkins and the Warden (see Miscellaneous notes).

A long-tailed duck was in the Hole, off Beach Point, on October 29th.

Three grey crows were feeding on the shore on November 4th.

A solitary snipe seen on November 8th allowed a very near approach before it flew and the white on the tail feathers was clearly visible.

BLAKENEY POINT.

(Notes from the diary of the Warden, Ted Eales).

The immature white-tailed eagle which first arrived in this area on December 10th, 1949, was seen almost daily until January 20th. Sometimes it was flying a short distance offshore, sometimes hunting the sandhills and once or twice it was seen resting on the beach. On several occasions it flew inland towards the woods above Cley and Blakeney and was last seen on the Bayfield Hall estate on the 20th.

A black redstart was seen on September 26th.

It was noticed on September 28th that nearly all the shelduck had left.

On October 1st and 2nd there was an unusually large movement of goldcrests with a number of whinchats.

Eleven grey lag-geese were seen flying eastwards on October 16th.

A peregrine falcon was seen over the harbour on October 22nd. A merlin was also seen on the 23rd in pursuit of a woodcock.

The first Brent geese of the season arrived in the harbour on November 13th.

A very large movement of starlings was seen on November 18th, 19th and 23rd when they were passing through all day long.

A white-fronted goose flew down the harbour on November 27th.

Seven little auks were seen on the outer bar of the harbour on November 29th.

CLEY AND SALTHOUSE.

Monthly records from the diary of W. F. Bishop.

(With additional notes by Mrs. R. N. Meiklejohn and Major A. Daukes).

JANUARY.

The year began with mild open weather and light S.W. wind. This later became easterly and a short cold spell with light snow and hard frost began on the 19th.

A small party of shorelarks seen on January 2nd frequented the N.W. boundary until April 17th when a single bird was there. Waxwings were noted on the 4th, 7th, and 9th. There was no marked immigration this winter and not more than five birds were seen at one time. A purple sandpiper was feeding on the mud near Blakeney Quay on the 6th. Song Thrushes were in full song on the early morning of the 10th, a fine mild day. There was a notable increase of finches on the marsh on the 16th and it was estimated that the gathering of snow-buntings, bramblings, chaffinches and greenfinches numbered

1,500 birds. The immature white-tailed eagle which arrived in the district on December 10th was seen at Bayfield on January 16th and flying inland over Cley on the 18th and along the beach on the 20th. An influx of duck took place on the 20th and there were many more on the marsh than previously this winter. A merlin and two hen-harriers were hunting the marsh on the 27th, and the harriers were there again on the 30th. Three whooper swans flew over on the 28th. A party of nine Brent geese arrived at Salthouse on the 30th. On the last day of the month fifty shield-duck had returned there.

FEBRUARY.

This was a wet month with strong winds reaching gale force on the 2nd and 9th.

A purple sandpiper was feeding on the Salthouse side of the E. Bank on the 6th. On the same day a black-necked grebe was in the main drain of the Cley marsh. A great northern diver was fishing close inshore under the lee of the shingle ridge on the 10th. A peregrine flew over the marshes on the 11th. On the 13th Bishop flushed five woodcock from the marsh which he thought might be preparing for the return journey to the Continent. A fine white smew drake was at Salthouse on the 23rd. A skein of grey geese, believed to be pink-footed, flew over the marsh on the 24th. Very few were seen this winter.

MARCH.

A fine month with only one day of heavy rain, and several beautiful warm spring-like days. During the last week, however, the wind veered to the north and it was much colder again.

A bittern began trying its voice on the 1st and again on the 4th. By the 18th it was booming well and on the 25th there were three booming from different parts of the marsh. Three woodcock were flushed on the 3rd. On the 7th, a fine warm day, green plovers were calling and somersaulting in nuptial display. One pair of garganeys arrived on the 9th and there were four pairs on the Big Pool on the 23rd. The first two ruffs were seen on the 10th and were joined by three more on the 17th. The spring call and flight of redshanks began on the

13th. The first wheatear and a chiffchaff arrived on the 19th and three Sandwich terns were seen flying over the East bank on the last day of the month.

April.

Strong N.W. wind at the beginning of the month coinciding with a full moon caused some anxiety, but although the sea washed over the shingle ridge it did not break through, and most of the surplus water was carried off by the main drain. The water on the Salthouse marshes remained six inches above normal for some days and during this time was too deep for waders. On April 25th snow fell to a depth of three inches.

Two pairs of pintail were on the Big Pool on the 5th. On the 7th there was an almost continuous east to west movement of swallows and martins, and on the same day large numbers of Sandwich terns arrived. Sixty of these alighted on the Cley marshes and about 250 on Salthouse. On the evening of 12th there were nearly 500 resting at Salthouse. A bittern's nest with four eggs was found on April 7th and a second one also with four eggs on the 18th. Both nests were hatching on the 24th and 25th during a heavy fall of snow. Two chicks in one of these nests which was left uncovered while the parent bird was hunting for food, died from exposure. The two eggs which remained were deserted. Yellow wagtails arrived on the 12th. On April 17th a pair of avocets were seen by Mrs. Meiklejohn and Mr. Richardson ; also four black-tailed godwits.

May.

For the most part May was a cool month with a good deal of wind from the north and east.

A black-tailed godwit was seen at Salthouse on the 1st and a late purple sandpiper was feeding on Cley marsh. On the 2nd a wader believed to be a little ringed plover was seen at Salthouse and this was identified as such on the following day by Mrs. Meiklejohn and Mr. Richardson. The note was heard and the absence of white on the wing remarked. The first brood of young mallard was seen on the 3rd. Black-headed gulls nesting on the marsh began laying on the 4th. A large movement of sand-martins was observed on the 5th and

the first swift was seen on that date. Three pairs of garganey teal believed to be nesting on the marsh were seen on the 6th. On the 10th bitterns were very active over the marsh obviously busy feeding young, and Bishop watching them was convinced of four pairs. Later, on the 20th, young bitterns sitting outside a reed-bed in view from Bishop's cottage established the fact that five pairs bred this season. On the 17th a nest with four eggs was found within thirty yards of another one. It was believed that this was a second attempt made by the birds who lost their chicks in the bad weather and late snow of April. Three ruffs arrived on the 11th, one with a pure white and two with black ruffs. They were joined by two reeves the following day and remained until the 13th. A pair of bearded tits were identified by Major Aubrey Buxton on the 13th and were seen by Bishop the next day and again on the 18th. A single cock was also seen on the 30th. Two little stints were on Salthouse on the 16th. A Temminck's stint was seen at Cley on the 17th and at Salthouse on 20th. A single avocet alighting on Salthouse marsh on the morning of the 18th was joined by two more in the evening, but they did not stay. On May 21st there was a large immigration of wagtails. Associated with these, grey-headed wagtails (*motacilla flava thumbergi*) were identified at Salthouse by Mrs. Meiklejohn and others, and a blue-headed wagtail at Cley by Mr. M. Seago and Mr. B. Palmer. On the 22nd there were two male and four female grey-headed on Salthouse. All the birds had left the following day. A brood of common teal was hatched on the 26th. A single avocet alighted on Salthouse Broad in the late evening of the 30th, but did not stay.

JUNE.

This was the best month of the summer, warm with light winds and very little rain.

The first of the twenty-four redshank's nests hatched on June 2nd. It was estimated that in all there must be at least fifty pairs on the Cley marshes. Two spoonbills were at Salthouse from the 3rd to 6th and one remained until the 9th. A wood sandpiper first seen by Mrs. Meiklejohn on the 3rd stayed on the marsh for three days. A count of the

common terns' nests on Salthouse marsh was made on the 7th the total being twenty-nine. Two avocets arrived at Cley on the 8th, but left next day. A spoonbill was seen in Cley channel on the evening of the 9th. Green sandpipers arrived on the marsh on the 22nd. On the 24th a dusky redshank in full breeding plumage was seen at Salthouse by Mrs. Meiklejohn. On the same day she and Mr. Richardson had a wonderful view of two red-necked phalaropes flying in from the sea which, as they lit on the Big Pool, proved to be a male and female. The male bird was seen again next day. The late booming of a bittern was heard on the 25th. A count of house-martins' nests under the eaves of Watchers Cottage on June 29th totalled fifty-three.

JULY.

July proved to be a very wet month and the water on the marshes was unduly high for the time of year.

A review of the breeding season made at the beginning of the month showed it to have been a poor one for ducks with only about half last year's number of young birds reared. The first young sheld-ducks to fly were on the wing on the 11th. There were records of a little stint on Salthouse marsh on the 13th, 21st, 22nd and 28th, and of a dusky redshank there on the 13th, 22nd and 28th. A late brood of shovelers, thought to be about ten days' old, were seen at Cley on the 26th. A noticeable westerly movement of whimbrel took place on the 29th.

AUGUST.

This was a cool month for the time of year, and showery with several heavy thunderstorms.

Two avocets were seen in Cley channel by Sir Lawrence Bragg on the 8th. A dusky redshank was on Salthouse marsh on the 9th. Wood sandpipers occurred several times during the month and were noted on the 9th, 16th, 23rd and 24th. The first common sandpipers of the return movement arrived on the 9th. Greenshanks were passing through in some numbers and on the 16th a party of fifteen to twenty was flushed from one small pool on Cley marsh. A little ringed plover was watched by Major Daukes on the 18th, 19th and 21st. A westerly movement of whimbrel, curlew and greenshanks took place on the 23rd and again on the 30th

when green plover were also passing through. A marsh-harrier was hunting over the area on the 25th, 27th and 31st. A party of six ruffs and reeves which arrived on the 28th remained until the last day of the month. Gannets and skuas were passing offshore on the 30th.

SEPTEMBER.

After a fair warm start the weather deteriorated and there was a good deal of wind towards the latter part of the month with heavy showers.

Small parties of black terns were hawking over the pools on the 1st, 2nd and 12th, five being the most seen at one time. Green, common, wood and curlew sandpipers were all seen on the marshes on the 1st. A roseate tern was identified over Salthouse on the 12th. On the 6th both golden and grey plover were seen crossing the marsh. An American pectoral sandpiper, first reported at Salthouse by Mr. Hinde, was confirmed by Major A. Daukes and Mrs. Meiklejohn on the 7th. It was watched closely and by the 15th Major Daukes was convinced that there must be two birds in the area. This was proved on the 17th when he saw one at Cley while another at Salthouse was being watched by Mr. and Mrs. Rose. Nine grey lag-geese flew over in an easterly direction on the 21st. A large scale movement of rooks took place on the 14th, and of rooks and green plover on the 23rd, 27th and 29th. The first grey crow arrived on the 14th. Two Lapland buntings, with one snow bunting, were identified on the 23rd at the end of the East Bank, and were seen several times after this date. A Jack snipe, the first of the season, was flushed on Cley marsh on the 27th. On the 30th the water which had been four inches above normal on Salthouse marsh had fallen and numbers of waders were feeding there. These included little stints, curlew sandpipers, grey plover, a dusky redshank and fourteen Sandwich terns. On the same date a pectoral sandpiper was seen flying low over the East Bank.

OCTOBER.

A month of strong winds which, in the second half, were from the north and east.

Twenty Jack snipe were flushed on Cley marsh on the 3rd.

The following birds were seen on the 6th by Mrs. Meiklejohn during a walk from Cley to Blakeney Point :—A black-tailed godwit, fifty redwings flying in from the sea and a peregrine disturbed by a hen-harrier while it was feeding on a stock dove ; the two birds presented a lovely sight in the air together. Also in the suaeda bushes was a whinchat, a wheat-ear, a pied flycatcher and some blackbirds.

Six unidentified pipits of greenish colour were on Arnold's marsh on the 7th. On the 7th bearded tits were seen on the marsh and again on the 20th and 24th when there were five birds. The first bramblings arrived on the 19th. A flock of about 100 snow-buntings were nearby. These were still about on the 28th. A woodcock was flushed on the marsh on the 23rd and another from a reed-bed on the 27th. On the 31st Mrs. Meiklejohn saw a long-tailed duck flying by close inshore.

November.

A very cold and wet month with twice the average rain fall, and high winds reaching gale force on the 17th.

In a strong N.E. wind a hen-harrier was hunting the marsh on the 2nd. Two short-eared owls were over the coast road on the 4th and again on the 7th. Two purple sandpipers, one on the Cley marsh and one on Salthouse were seen on the 7th. Ducks on the marsh had increased in number on the 8th, but by the end of the month there were very few left. The flock of snow-buntings on the N.W. boundary continues to increase in number and on the 13th was estimated at over 100 birds. A velvet scoter was seen by Mrs. Meiklejohn on the 18th, Lapland buntings were seen again on the 13th, and up to the end of the month. It would seem that a number of these birds were going through between September 23rd and the end of of November. A great grey shrike was seen on the Beach road on 22nd. A skein of ten pink-footed geese circled round the Cley marsh two or three times before flying off on November 27th.

DECEMBER.

The first snow fell early in the month, and, after a short thaw, more very cold weather with hard frosts and blizzards set in on the 15th. There was little bird life on the marsh at this time and fewer ducks than usual. A great grey shrike was seen on the 9th, and another on the 30th. Seven whooper swans flying west were seen offshore on the 17th.

BIRD NOTES FROM HICKLING.

(FROM THE DIARY OF E. PIGGIN).

The largest gathering of duck on the Broad during the winter was in the third week of January just before the coldest weather set in. The numbers estimated at that time were 400 wigeon, 500 mallard, 150 tufted, sixty pochard and fifty goldeneyes.

Eight grey lag-geese were seen on January 14th flying over the Broad towards the south-west. Ten whooper swans arrived on January 18th.

BREEDING SPECIES.

Bearded Tit.—These had an excellent season. Seventeen nests were found and in fifteen of these five, six or seven young were reared. Two nests were deserted after a night of rain, hail and snow on April 24th. The first brood of fully fledged young was found on April 14th ; the last nest, with five eggs, on July 5th. An unusual record is of five freshly laid eggs in a nest from which a brood of seven young had recently flown. The nest was naturally in a foul state and it was probably for this reason that the five eggs were deserted.

Grasshopper, Sedge, and reed-warblers were as numerous as usual and many nests were found.

Marsh-harrier.—Three were over the Broad on April 15th and a nest with one egg was found on the 26th. Four young, hatched in a nest on Warbush marsh, were drowned in a heavy thunderstorm.

Montagu's Harrier.—None nested for the second year in succession although they were seen over the Broad on May 1st and several times during the season.

Garganey Teal.—From the behaviour of the drakes it was judged that twelve pairs bred. The favourite nesting area is the grassy marsh of Heigham Holmes.

Great Crested Grebe.—Seven nests were found in all of which the young were reared.

Coot.—There were more than the average number of breeding pairs.

Water-rail.—Four nests were found as the young were leaving them.

Bittern.—These had a good season. Preliminary booming was heard on March 3rd and was in full swing on April 12th. One bird frequently boomed eight times in succession. Three nests were found, the first with three eggs on April 26th. Two, three and four young were reared in these nests.

Owls.—Three pairs of barn owls nested at Hickling. One pair of tawny and one pair of little owls also bred in Town wood.

An interesting record is of redshanks, snipe, green plover, skylarks and meadow pipits all nesting on a re-seeded marsh on the west side of the Whiteslea roadway.

Passage Migrants.

These records include some made by James Cadbury during his stay at Whiteslea Lodge during August.

Hoopoe.—On April 29th, George Bishop, assistant keeper at Whiteslea, identified a hoopoe which was feeding on a rough marsh of scrub and small trees not far from the Lodge. It was still in the same area on the following day, where it was watched by three visitors but it would not allow close approach and eventually flew off towards the coast in a north-easterly direction.

Flycatchers.—Pied and spotted flycatchers were passing through on April 25th.

Hen-Harrier.—A female was hunting the marshes on November 16th, and a pair was seen over Deary's marsh on November 20th.

Copyright

Little Owls, Hickling.

W. E. Higham

Spoonbill.—One arrived on Rush Hills on July 21st and remained on the Broad for two days.

Little Stint.—One identified with a party of dunlin on Rush Hills on August 13th (J. C.).

Ruff.—A reeve was seen on Rush Hills on August 17th and 18th. Four more arrived on Deary's pool on the 25th and were joined by a ruff (J. C.).

Dusky Redshank.—A bird which appeared to be changing from summer into winter plumage arrived on Deary's just after the rond had been flooded on August 25th (J. C.).

Whimbrel.—These were passing over on May 11th in some numbers. Single birds were seen during the return migration in August.

Greenshank.—Spring records are of one bird on Rush Hills on May 1st and of two there on May 12th. There was a steady passage during August, eleven being seen on the 15th.

Black-tailed godwit.—One on Rush Hills on May 9th and another on June 10th.

Golden Plover.—Three seen with a party of fifty young lapwings on Rush Hills on August 13th (J. C.).

Black Tern.—A number were feeding over the Broad during May, as many as twenty-three being counted at one time. A single bird in winter plumage was seen in company with sand-martins on August 29th (J. C.).

HORSEY.

By Major Anthony Buxton.

I do not remember a season when so many nests went wrong, or when so few young birds seem to have survived. Very heavy rain accounted for a number of disasters, birds and beasts of prey for others, and human interference for the rest. This is all very disappointing for in some ways it looked like being a record year.

In the winter of 1949—50 there was certainly something wrong with the weed in Horsey Mere. It was not attractive either to swans, surface feeding or diving duck. The most

attractive food at any rate for pochard seems to be the hard brown seeds of a weed called Chara Rispida. There was a number of teal in the neighbourhood in October, but the only large collection of duck appeared in the hard spell at the end of January and beginning of February. At that time the Mere was all covered with ice except for a narrow lane of water near the south shore, which kept open all the time. It is reckoned that there were at times 3,000 fowl on it—whooper swans, mallard, wigeon, pintail, teal, pochard, tufted, golden-eye, scaup and two smew. On some days mallard, on others wigeon, and on others pochard were the most numerous. There were never any quantity of coots on the Mere.

To return to the spring and summer. A strange wader was seen at close quarters by Mr. J. Lockett and Mr. George Crees, the keeper. After looking up illustrations they independently came to the same conclusion that it appeared to be a Terek sandpiper. I know the Terek country and the Terek river, which flows from near Mount Kasbek into the plain north of the Caucasus, but I have never seen its sandpiper and can therefore give no opinion about the bird. Great numbers of whimbrel went north in May and curlew westward in June. Several ruffs and reeves were seen and some of the ruffs displayed.

For the first time that anyone at Horsey can remember we had an oyster-catcher's nest. It was on bare soil on a marsh on which re-seeding failed. I have never understood why oyster-catchers do not breed on or near the sandhills in the neighbourhood, but so far as I know they never do and the background selected for the eggs and sitting bird was most unsuitable. The farmer kindly agreed not to do any more work on that marsh until the young oyster-catchers were safely hatched.

In addition to the wood-pigeons which crowded into the garden to nest, eat the peas and anything else which they and we habitually enjoy, large flocks of these birds concentrated on the parish in April, probably before their departure overseas. We were also rich in turtle doves and there were several pairs of stock-doves, with the result that the cooing chorus was so loud and persistent that one came almost to ignore it.

Every year some bird seems to appear in record numbers. In 1950 it was the spotted flycatcher, with linnets a good

second, but not up to 1949 in numbers. At the other end of the scale it was a remarkably bad year for greenfinches and sedge-warblers. After the sea-flood yellow wagtails greatly increased, but they are now beginning to drop back towards pre-flood numbers. Golden orioles passed quickly through the garden on three occasions between May 17th and 28th, a single cock, a pair and another single cock. There was nothing to suggest, as there has been on former occasions, that a pair might be nesting somewhere within a reasonable distance.

There were plenty of bitterns but they did not rear such large families as in 1949. Mr. Walter Higham from a hide in front of a bittern's nest containing one well-grown healthy chick and another hatched that morning, obviously a weakling, watched and filmed the parent bittern pick up the weakling which made feeble movements, put it down again, pick it up a second time when the response was still feebler, and finally pick it up by the hind leg and swallow it. She sat down shielding the healthy chick from the strong sun and in due course showed the usual symptoms of her intention of being sick. She was, but fortunately perhaps, only of an eel. After that Mr. Higham discreetly retired from the scene and went home, so that what, if anything, more happened to the swallowed chick is not known. I have reason to believe that this white rabbit out of the hat business is quite normal with bitterns. In fact they seem able to choose more or less what it shall be, but their choice of what to swallow is sometimes unpleasant, and of what to bring up sometimes foolish. On July 2nd a bittern was seen flying a long distance from the Mere to the North carrying a single reed. A bittern's nest is always in reed or in sedge surrounded by reed and it is impossible to imagine why the bird should have thought it necessary to carry a single bit of reed a long distance. There is no fathoming a bittern's brain. In December, when the Mere was very high, Mr. Crees saw a bittern move through the edge of a reed bed, about twenty yards without even touching the ground. It grasped the reed stems with its feet and so progressed from stem to stem. Presumably the water was too deep for wading.

Except at Starchgrass there were not so many water-rails breeding as in 1949, but there was a large movement of these

birds on or about April 4th. The peculiar fussy individual turned up again in the same place and was heavily photographed and filmed. It is not known whether this bird is the cock or the hen ; its mate's behaviour is calm and normal, and both of them are ridiculously tame, but the fussy bird is always shifting and shuffling its eggs, picking them up and looking at them and last year, apparently owing to draught, built a fresh nest with material from the occupied one a foot or two away, and transferred all the eggs to it within an hour. This year Mr. Higham and Mr. Crees arrived a little late for the hatch. When Crees picked up a chick in his hand, it was repeatedly and savagely struck by the bird's bill until he released the chick. The nest of this pair has been in almost exactly the same place each year. It is strange that so secretive a bird as a water-rail, which so seldom sees or is seen by human beings should be so exceptionally easy to tame. They seem to me very intelligent creatures and capable of dealing with any emergency.

For various reasons I shall not say much about harriers. At one time we had three pairs of Montagu's and one pair of Marsh-harriers all with full clutches of eggs, the greatest distance apart of any two nests being about 800 yards. Two pairs of Montagu's nested within about 200 yards of each other, which resulted in a lot of bickering particularly between the hens, and was extremely entertaining. One pair of Montagu's were obviously old friends of mine for they were ludicrously tame. On one occasion when two officials from the National Trust were with me and a friend watching from about 100 yards from the nest, the cock came in with a kill. He flew round looking at us and no doubt wondering whether it was safe to call off the hen and pass the prey to her in public. He came straight across our front and finally decided that it would be all right and called the hen up. We four were standing in full view about 100 yards from the birds and the glasses were handed to the National Trust. The cock dropped the prey in the air to the hen exactly in front of us, and the two representatives of the National Trust exclaimed simultaneously, " She has missed it." The hen circled round over the sedge, spotted the prey and picked it up. That is the first time I have ever seen an adult harrier miss a catch, and I can only

suppose that it was due to stage fright or to keeping one eye on the spectators instead of both on the ball. There was one mysterious character I never learnt anything about. She was a young hen marsh-harrier, dark grey-brown all over with a pure white head. No other harrier was ever seen to pay the smallest attention to her. She just wandered vaguely about alone all day, and was obviously a bit of a freak.

There were no short-eared owls breeding, but an increase in barn owls has occurred and we had three nests.

There were at least three pairs of bearded tits in the area, but I do not know how they fared, for we left them severely alone. A few of these birds spent the winter round Horsey Mere, but they have never returned since the sea-flood, to what used to be their main winter resort, a thick reed bed on Mere Farm. I imagine that the grubs they used to find in the reed there were destroyed by the salt, and that although the reed has recovered the grubs have not.

I have no definite evidence that common teal bred at Horsey but up to ten were seen at the beginning of July. They all seemed to be adult birds. If they did in fact breed, I think it was for the first time since the 1938 flood. About a dozen garganey were seen in April but they disappeared for some reason unknown. One pair of shoveler was about in the spring and summer and probably nested. Before the flood their numbers in spring and summer were about the same as the mallard. Three black terns were seen in the middle of May, two black-tailed godwits on June 10th, one corncrake on May 3rd, a spotted shank on May 6th. No osprey was seen.

On September 7th Mr. G. Crees saw a quail by the Hundred stream.

On the 9th and 10th a Kentish plover was seen, the first record of this bird at Horsey. Three green sandpipers and one wood-sandpiper were also seen at this time.

THE SCROBY SANDS.

Report from R. H. Harrison.

The first trip to the Scroby Sands for bird observation this summer was made on June 4th. Although there were signs that many eggs had already been washed out by high tides

there was a good show of nests and eggs of the Common tern, a small colony of sandwich and six nests of the Little tern. A party of 100 kittiwake gulls were resting on the bank.

A second visit was made on June 18th. This time there were 170 Common terns' nests, eighty-five Sandwich and fifteen of the Little tern. The kittiwakes had increased to between 250 and 300 birds. Fifty seals were resting on the N.E. corner of the sands.

On July 2nd the colony of Sandwich terns had increased to 158 nests. Recent high tides had washed out more of the Common terns' eggs and Great and Lesser black-backed gulls were gorging on them. There were a number of chicks of which twenty Common, seventeen Sandwich and three Little terns were ringed.

A week later it was found that almost the whole colony had been washed out by the storm which occurred on July 3rd and scores of eggs and chicks littered the tide-mark. However, none of the adult birds appeared to have left and there was evidence of fresh attempts to nest for eggs of both Common and Sandwich terns were found.

On July 23rd many eggs were still on the sands but there was no sign of any chicks.

The final trip was made on August 3rd. Large numbers of adult terns, Common and Sandwich, were in the vicinity of the sandbank but no young were seen.

This is the second year in succession that the breeding season has been a complete failure and it would seem that this is bound to happen until the sand accumulates again and the Scroby bank has risen to its former level prior to the storms of early 1949.

MISCELLANEOUS NOTES.

Hooded Crow

Fifty-six were resting on the ice of Ranworth Broad on January 28th. (Paul Kirby.)

Golden Oriole

One was seen on the road between Field Dalling and Bale on May 14th by Mrs. Clogstoun and a friend.

NORTHERN BULLFINCH

A particularly large brightly plumaged cock was tapping on the kitchen window of my house on October 22nd, and I feel sure from its spruceness that it was not an escape and judged it to be a northern bullfinch. (Dr. L. Ley.)

TWITE

Eight arrived at Breydon on October 14th and had increased to over forty by early November. They spend each winter on a rond by the north wall. (M. Seago.)

WOODLARK

A large increase in the number of woodlarks on Salthouse Heath and Cley Hall Farm was evident this year. On March 21st it was estimated that at least twenty pairs were in this area. (W. F. Bishop.)

BLUE-HEADED WAGTAIL

A fine male at Cley on May 21st feeding on the edge of shallow pools on the western boundary of the marsh. (M. S.)

GREY WAGTAIL

One which arrived at Wiveton Hall at the end of September remained until November 6th. It spent most of its time on the cow-house roof and sometimes went right inside. (Capt. R. G. Buxton.)

A lovely male at Hellesdon Mill on April 25th ; another there on November 11th. (M. S.)

ROCK PIPIT

Six feeding in a muddy creek at Morston January 8th. (P. K.)

GREAT GREY SHRIKE

One on Salthouse Heath on November 23rd, the day after one was seen on the Beach road at Cley. (Mrs. Meiklejohn.)

RED-BACKED SHRIKE

An estimate of twenty to twenty-five nests within a three mile radius of Cley marsh. A party of twenty, mostly young birds, seen on Cley Hall Farm July 20th. (W. F. B.)

WAXWING

Two feeding in a garden in Holt February 4th. (W. F. B.)

FIELDFARE

Late passage birds at Caister May 11th (two) and May 14th (four). (M. S.)

RING OUZEL

A pair at Swan Lodge farm, Holt on April 28th. (W. F. B.)

A female seen perched in the fork of a tree in Holkham Park April 7th. (W. H. Oughton.)

A party of three males on Caister golf course April 23rd; another there May 11th. The first I have seen here. (M. S.)

STONECHAT

Two on Caister Denes October 29th, the first there for several years. (M. S.)

REDSTART

One passing through at Yarmouth May 12th. (M. S.)

BLACK REDSTART

A male singing from ruined houses on a Yarmouth bombed site until the second week of July. (M. S.)

The following Notes on Black Redstarts breeding in Yarmouth are from R. Harrison :—

A nest with four eggs was found on May 4th. This was situated in a hole on a wall on a bombed site in Yarmouth. Three young hatched on May 14th, there being one addled egg. This nest was tampered with later and one nestling was found dead on the ground, but the parent returned to care for the remaining two. These left the nest on May 29th and were ringed. The male of this pair appeared to be a first year bird.

A second pair, first seen on May 7th, also nested on a bombed site about a mile from the others. The nest was inaccessible as it was high up amid old rafters on very unsafe walls. During the latter half of May the male was seen carrying food to it. This bird was darker than the male of the other pair with more conspicuous white on the wing.

The third pair was found by a friend to be nesting inside an old air-raid shelter within a hundred yards of the harbour mouth at Gorleston. The nest with three young was found on June 7th. These were successfully reared and left the vicinity a few days after leaving the nest.

This pair had a second clutch, using an old nest on a wooden rafter upon which were the remains of five old nests. From this it seems obvious that black redstarts have been breeding there for at least two years if not more. The first egg of this second clutch was laid on June 26th and on June 30th there were five. Five young were hatched on July 13th and left the nest, after ringing, on July 27th. By July 30th both young and parent birds had left the locality.

An interesting point in regard to these nesting records is that the male bird did all the feeding of the young, and on one or two occasions was seen to turn the brooding female off the nest in order that he could feed the nestlings.

Black Bellied Dipper

One by a disused mill on the river Wensum, near Norwich, on November 11th is the first recorded in the county for a number of years. It was slate-black above merging to dark brown on the head, with white chin, throat and upper breast and blackish lower breast and belly. There was no trace of a chestnut band on the lower breast. It was very tame and was seen by several observers. (M. S.)

One seen at Hoxne on November 21st and 25th where the river Waveney forms the boundary between Norfolk and Suffolk. (R. P. Bagnall-Oakeley.)

Major Lloyd of Taverham Mill also saw one in November.

Hoopoe

One at Hickling April 20th—21st.

A hoopoe was also seen at Blakeney on April 24th by W. F. Britten.

Peregrine Falcon

One passing northwards over Breydon April 27th. Another there October 1st chasing small waders. (M. S.)

A peregrine spent the winter around the Breydon area where it appeared to get an easy living at the expense of small waders, chiefly dunlin. (R. Harrison.)

Grey Lag-Goose*

One at Breydon March 12th, near Duffel's Rond. (M. S.)

PINK-FOOTED GOOSE

The number wintering on the Halvergate and Breydon marshes was again small. The peak was reached about November 27th when there were about 400 and these remained until March 7th. (R. H.)

WHITE-FRONTED GOOSE

Very late in arriving on the Breydon marshes due possibly to the mild weather. On January 21st a gaggle of about 150 arrived and by the 28th these had increased to 600. They had all left by March 5th. (R. H.)

BEAN GOOSE

A small flock of fifty-four reached the Buckenham marshes during January. These also left earlier than usual and were not seen after March 4th. (R. H.)

WHOOPER SWAN

Three immature birds on the Breydon mud-flats Feb. 11th. (R. H.)

SMEW

One adult male Ranworth Broad January 21st. A pair also there on February 25th. (P. K.)

A pair at Hickling February 26th, and a fine male on Rollesby Broad March 5th. (M. S.)

RED-BREASTED MERGANSER

One at the east end of Scolt Head Island August 21st, 23rd. It was first seen resting on the sand with gulls and cormorants and later moved down to the sea. (W. Kenrick.)

GOOSANDER

A female alighted on the mudflat near my houseboat, February 12th. (R. H.)

Two females on Ranworth Broad, January 21st and 22nd. One female on Rockland Broad February 19th. (P. K.)
One on Holkham Lake, December 29th. (Miss J. Ferrier).

SPOONBILL

Grand party of five asleep on Breydon at high water, June 9th. Two were immature birds. They made a wonderful picture when in flight. At sunrise next morning three remained but these soon departed northward. (M. S.)

Red-breasted Snipe

While walking across Scolt Head Island on October 29th with Capt. and Mrs. Scott-Moncrieff we flushed from some marram grass near Norton creek a bird which at first sight appeared to be a woodcock. As it flew away from us we noticed that its plumage was greyish-brown except for a pure white patch in the middle of its back ; there was no wing-bar nor any noticeable barring on the tail. The bill was long and perfectly straight ; the legs appeared dark and did not project beyond the tail. The bird settled on the mud some 300 yards away and we were able to approach to within about half this distance. On the ground it was noticeably smaller than a godwit and its stance that of a snipe with the long bill pointing downwards. In colour it appeared a uniform grey above except for the lower back which was white. The underparts were grey, slightly darker on the breast and nowhere noticeably white. The bird did not permit of closer approach and flew silently and rapidly away across Norton creek towards the mainland.

Since I am familiar with the common shore-waders and since the two most noticeable features of this bird, the long straight bill and white patch in the centre of the back, are characteristic of the Red-breasted snipe (Macrorhamphus griseus) I have no hesitation in identifying this bird as one of this species. (David Jenkins.)

Little Ringed Plover

One at Salthouse was identified on May 3rd by Mrs. Meiklejohn and R. A. Richardson. The note was heard and absence of white on the wing noticed. Another was seen at Cley on August 18th, 19th and 21st by Major A. Daukes.

American Pectoral Sandpiper

A bird of this species was seen at Salthouse by Mrs. Meiklejohn and Major A. Daukes on September 7th. Later another one arrived and the two birds were seen on the 17th.

Black-headed Gull

A count of 629 nests was made on Alderfen Broad in early June, a large increase on last year's numbers. (M. S.)

Glaucous Gull

An immature bird at Breydon November 4th. (M. S.)

LITTLE GULL

A juvenile flying close inshore off Cley beach September 10th. The wing pattern, bouyant tern-like flight and more rounded wings than those of the Black-headed gull were features noticed. (P. K.)

GREAT SKUA

One close inshore between Cley and Salthouse September 6th. It flew up from the sea to chase Sandwich terns and some fine acrobatics were witnessed. (W. H. Oughton.)

Two seen off Cley beach September 10th. (P. K.)

ARCTIC SKUA

One at Winterton August 7th. Twelve birds seen separately off Cley beach all flying west September 10th. (P. K.)

LONG-TAILED SKUA

An adult (pale) seen close off-shore on Sept. 12th and 13th. (Major A. Daukes).

MANX SHEARWATER

Three single birds seen flying west close inshore off Cley on September 10th. The rapid gliding flight just over the crest of the waves and the black and white plumage were clearly seen. (P. K.)

Manx Shearwaters were also seen off Cley on September 9th by Mr. Rose and several friends, and almost daily during the rest of their stay.

FULMER

Twelve were first seen at Sheringham on February 5th and forty were present on May 13th. Fourteen pairs, apparently nesting, were counted in June.

Three young birds were seen on August 27th. (J. and M. Marsham.)

RED-NECKED GREBE

One at Ranworth Inner Broad February 12th. It was assuming breeding dress. (M. S.). Also seen by Paul Kirby on February 4th.

SLAVONIAN GREBE

Two on Filby Broad March 5th. These were diving within two feet of the road bridge and sketches were made of the head and bill. (M. S.)

One at Horsey Mere January 1st and one on Ranworth Broad February 4th and 5th. (P. K.)

Turtle Dove

Two late birds on the Wells-Stiffkey road October 5th and another at Holkham October 17th. (W. F. B.)

* N.B. The grey lag-geese reported are probably members of two home-bred flocks, Capt. H. J. Cator's at Woodbastwick or Mr. C. Gowing's at Rackheath. These birds are known to roam all over the County and especially to Breydon. Wild grey lags are rare in Norfolk.

CLEY BIRD OBSERVATORY.

The Observatory's first full year, which was largely exploratory, ended on September 30th, 1950 and conforms with the official year of the Bird Ringing Committee at the British Museum.

The main work has been the trapping and ringing of both passage imigrants and breeding species and has yeilded encouraging results. 1,252 birds of sixty species were ringed during the year, 651 being trapped and 601 as nestlings.

Special mention may be made of 143 snow-buntings, twenty-two bramblings, seven black redstarts (including two of the Yarmouth nestlings), five Greenland wheatears, two young bitterns, woodcock, dunlin and five trapped redshanks (including one of the Iceland race).

The Heligoland trap has accounted for most of the trapped birds with clap-nets running a close second. The remainder were caught in home-made spring and maze-traps of various experimental patterns.

The lack of cover in the shape of bushes remains a problem but intensive planting of suitable shrubs and trees during the autumn should improve the situation this year.

The ringing work continues, together with daily recording of bird movements in relation to wind and weather and the warden is planning a study of the meadow pipit, of which fifty were marked with coloured plastic rings last year.

Thanks are due to those who have so readily helped in the work of the Observatory.

LIST OF BIRDS RINGED.

Species.	Trapped.	Nestlings.	Total.
Starling	26	—	26
Greenfinch	65	11	76
Goldfinch	1	—	1
Linnet	48	18	66
Chaffinch	50	17	67
Yellow Bunting	1	10	11
Reed-Bunting	23	8	31
Snow-Bunting	143	—	143
House-Sparrow	111	1	112
Tree-Sparrow	24	—	24
Wood-Lark	—	8	8
Skylark	12	35	47
Meadow-Pipit	5	46	51
Rock-Pipit	5	—	5
Yellow Wagtail	—	9	9
Pied Wagtail	—	5	5
Great Tit	5	8	13
Blue Tit	30	13	43
Coal-Tit	—	9	9
Red-backed Shrike ...	—	5	5
Spotted Flycatcher ...	2	4	6
Pied Flycatcher	6	—	6
Goldcrest	1	—	1
Willow-Warbler	4	16	20
Reed-Warbler	—	5	5
Sedge-Warbler	—	11	11
Blackcap	1	5	6
Whitethroat	—	20	20
Lesser Whitethroat ...	2	—	2
Song-Thrush	1	59	60
Blackbird	11	85	96
Wheatear	15	6	21
Whinchat	1	—	1
Redstart	2	—	2
Black Redstart	5	2	7
Nightingale	—	5	5
Robin	11	36	47

Species.	Trapped.	Nestlings.	Total.
Hedge-Sparrow	3	32	35
Wren	1	2	3
Swallow	3	8	11
House-Martin	1	3	4
Nightjar	—	2	2
Little Owl	—	2	2
Barn-Owl	1	4	5
Bittern	—	2	2
Sheld-Duck...	1	—	1
Wood-Pigeon	—	1	1
Stock-Dove...	—	2	2
Turtle-Dove	—	2	2
Woodcock	1	—	1
Dunlin	1	—	1
Redshank	5	8	13
Ringed Plover	—	23	23
Lapwing	—	16	16
Oyster-catcher	—	1	1
Common Tern	—	2	2
Little Tern	—	5	5
Black-headed Gull ...	—	29	29
Razorbill	1	—	1
Totals	651	601	1,252

1,252 Birds of 60 Species.

RECOVERIES.

Recoveries of ringed birds have been reported as follows. All were marked and recovered at Cley unless otherwise stated.

STARLING

Male, SV.585, ringed 27.3.50; crushed by loose tile at nest of young at Perstorp, S. Sweden, 4.6.50.

GREENFINCH

Female, SV.548, ringed 31.1.50; killed by cat at Wiveton, 13.8.50.

CHAFFINCH

Female, F.7632, ringed 1.11.49 ; re-trapped 26.10.50.

Female, F.7895, ringed 14.11.50 ; re-trapped 7.11.50.

Male, F.7905, ringed 21.2.50 ; re-trapped 26.10.50 and wintered.

SNOW-BUNTING

Female, F.7675, colour-ringed 4.12.49 ; seen 18.11.50.

HOUSE-SPARROW

Male, BE.738, ringed at roost 6.4.49 ; found dead 15.3.50.

Male, F.7606, ringed 20.10.49 ; re-trapped at roost, 6.10.50.

Female, F.7614, ringed 24.10.49 ; found mummified with others in blocked chimney at Cley, 7.12.50.

SKYLARK

Male, colour-ringed as nestling, 10.6.49 ; wintered and bred in 1950.

BLUE TIT

Adult, F.7885, ringed 11.2.50 ; killed in mouse-trap, 16.12.50.

BLACKBIRD

RK.651, ringed as nestling, Thorpe, Norwich, 31.5.50 ; found dead on railway line near Salhouse, November 1950.

BARN-OWL

AD.6882, ringed as nestling, Morston 20.6.50 ; found drowned in water tank where ringed, 27.7.50.

BITTERN

506641, ringed as nestling 16.5.50 ; injured by lorry near Macclesfield, Cheshire, 6.11.50. Successfully nursed at Manchester Zoo and safely released 21.11.50.

REDSHANK

Adult, SV.544, ringed 30.1.50 ; shot at Blakeney, 13.12.50.

RINGED PLOVER

Male, colour-ringed as chick, 2.6.49 ; seen 23.6.50.

V

THE ECOLOGICAL STATUS OF THE BARGATE NATURE RESERVE

By J. M. Lambert

1. Introduction.

The area now known as the Bargate Nature Reserve was acquired by the Norfolk Naturalists Trust in 1948, through the generous gift of Judge J. Norman Daynes, K.C. It consists of a tract of rough fen in the Yare valley, situated in a bend of the river at the eastern end of Surlingham Broad. Lying thus in the alluvial flats of the river Yare, it forms an interesting complement to the Trust's other Broadland properties associated with the Bure and its tributaries, especially since vegetational differences between the fenland of these two river valleys are very marked.

A preliminary survey of this recently-acquired area was made, under direction, by a small party of graduate students* from Westfield College, University of London, during a short expedition to Norfolk in July, 1950. Some of the results of this survey, supplemented by a certain amount of later work† carried out during August and September of the same year, are set out in the following pages to provide a brief introductory account of the general character, stratigraphy and vegetation of the Reserve.

2. General description of the area.

The Bargate Nature Reserve, some 45 acres in extent, occupies a small meander loop on the south-west side of the Yare, lying between the river and the shallow expanse of open water traditionally known as Bargate ; the latter, together with a number of narrow, twisting reed-choked waterways and isolated pools and pulk-holes, represents all that now remains of the once extensive Surlingham Broad stretching west of the Reserve. Bargate itself is connected with the main river by

*The following Westfield students participated in the survey :—H. Catchpool, A. Craig, S. Hewitt, J. Kerslake, R. Vaughan, P. Wright.

†Assistance in the later stages of the work was given by :—A. Day, A. Green, A. Jermy (City of Norwich School) ; P. Croghan, L. Frost (Cambridge University).

dykes, of artificial origin, both above and below the Reserve, so that the latter is thus completely separated from the mainland and can only be approached by boat.

In Fig. 1, the position and general character of the Reserve is shown in relation to the adjacent fenland occupying the alluvial flats between the south-west river bank and the bordering upland. This fenland for the most part consists of unembanked and undrained former " mowing-marsh," now seldom cut and colonised in many parts by carr ; the dykes here are completely open to the river, and subject to a similar tidal rise and fall. Below Rockland Broad, the tidal water has been excluded by embankments, and the fenland drained by means of pumps to form wide grazing levels. Both the present Bargate Reserve and the area immediately south of it are similarly embanked, and were effectively drained at some time in the past ; according to local information, these two areas have been extensively used for grazing, and even in parts for the growing of summer wheat. The Reserve's old local name of " The Outmeadows " is a reflection of both its past economic status and its island position, and a narrow causeway, now overgrown and barred by numerous prostrate willows, marks the former means of access to the area from the upland. This causeway previously terminated in a ford leading to " The Outmeadows " across the south boundary dyke, but all remains of the original artificial hard bottom of this ford have now been removed by dredging.

The drainage of " The Outmeadows " was brought about in the past by a pump situated at its extreme south-east corner and fed by a system of interconnected collecting dykes. The earliest available large-scale map of the area—the 1840 Tithe map—shows that the embankments and main dyke system were in existence at least a century ago, though at that time drainage by windmill and scoop-wheel probably preceded the installation of the pump. The exact time at which active drainage was discontinued is uncertain, but it is known that the pump was eventually removed in 1914 ; it is probable that the great flood of 1912, which caused serious deterioration of much of the drained fenland along the river, was largely responsible for the final disuse of the area as profitable grazing land.

FIG. 1. Map to show the position of the Bargate Nature Reserve and its relation to the adjacent Fenland.

With abandonment of drainage, active maintenance of the embankments likewise ceased, and the latter have gradually reached a state of serious disrepair. The wide bank along the river itself is unbreached and still receives sporadic dumps of dredgings, but the smaller embankments bordering Bargate and the southern dyke are weakened and pervious in several places, largely due to the uprooting, during gales, of tall white willows grown from stakes originally set along the banks. The sluice at the south-east corner, formerly associated with the draining pump, is now no longer functional, and, together with the breaches in the embankment, allows ingress and egress of flooding tidal water, especially from the south. The main dyke system is still distinguishable, but most of the drains are choked with reed. Vertical air photographs taken by the R.A.F. in 1946 reveal the former existence of many subsidiary "grups" and "gripples," most of which are now completely overgrown and unrecognisable from the ground.

This progressive change in the general character of the area from drained pasture to waterlogged fen must obviously have been accompanied by a corresponding change in the natural vegetation, with increasing entry and spread of plants more typical of the adjacent undrained "mowing-marshes." The establishment of sweet-grass, reed and sedge naturally led to their exploitation by sporadic local cutting for fodder, thatch and litter, but this has declined almost to extinction within recent years, and now forms only an insignificant factor in any interpretation of the present distribution of the vegetation.

3. The stratigraphy of the area.

By virtue of its position in the flood-plain of the Yare, the Bargate Nature Reserve lies upon a vertical series of alluvial deposits built over the floor of the original eroded valley. Previous investigations by J. N. Jennings (University College, Leicester), based on the Ant and middle Bure, have revealed the general sequence of deposits in these valleys. The organic peats, which form the main alluvial fill, in parts show inter-digitations with soft grey clay wedges, representing past periods of marine transgression. Two such clay wedges, lying one above the other, have been identified within the middle

Bure, following the river course and thinning rapidly outwards from it. The upper clay is more extensive than the lower; it spans the valley in its lower reaches, but further upstream gradually tapers out. The major broads, their bottoms covered with organic muds, lie in the peat-lined basins between the valley margin and this diminishing clay flange.

Although a lower clay definitely corresponding to that of the Bure has not so far been found, preliminary investigations in the Yare valley have revealed other essential similarities. A petering clay wedge, directly comparable with the upper clay of the Bure, has been traced in borings extending between the Rockland-Claxton Level and the Surlingham Ferry quay. The upper limits of this clay lie fairly near the surface, covered at most by little more than a metre of subsequently formed peat. In the undrained "mowing-marshes," where this peat is possibly still accumulating, its layers remain intact: but in the areas which have been continuously well-drained, wastage of this surface peat through decomposition has frequently exposed the underlying clay, as in parts of the Rockland-Claxton Level, surveyed by a former Westfield party.

The alluvial deposits beneath the Bargate Reserve itself were identified and related to the general stratigraphy of the valley by means of a measured line of levelled bores, running approximately north-east to south-west from the river bank to the gently rising upland at the valley margin. The line of the section is shown in Fig. 1 (A—B); it traverses the long axis of the Reserve, diverges slightly across the Bargate open water, then runs straight again across the primary fen and carr south-west of the broad. The resulting data, considerably simplified, are incorporated in the generalised profile shown in Fig. 2. The boring apparatus used, with available rods only reaching to a maximum depth of 8 metres, was not long enough to reach the bottom of the alluvium near the river; further south-west, it showed the valley bottom to be almost flat beneath Bargate itself and much of the Reserve, but rising fairly steeply to form a shallow ledge nearer the marginal upland. The lower deposits consist of a great mass of brushwood peat, cut into by a channel of the soft grey clay near to the river course. Across the Reserve, the brushwood peat is replaced at higher levels by a layer of reed peat, with *Phragmites* as its chief constituent;

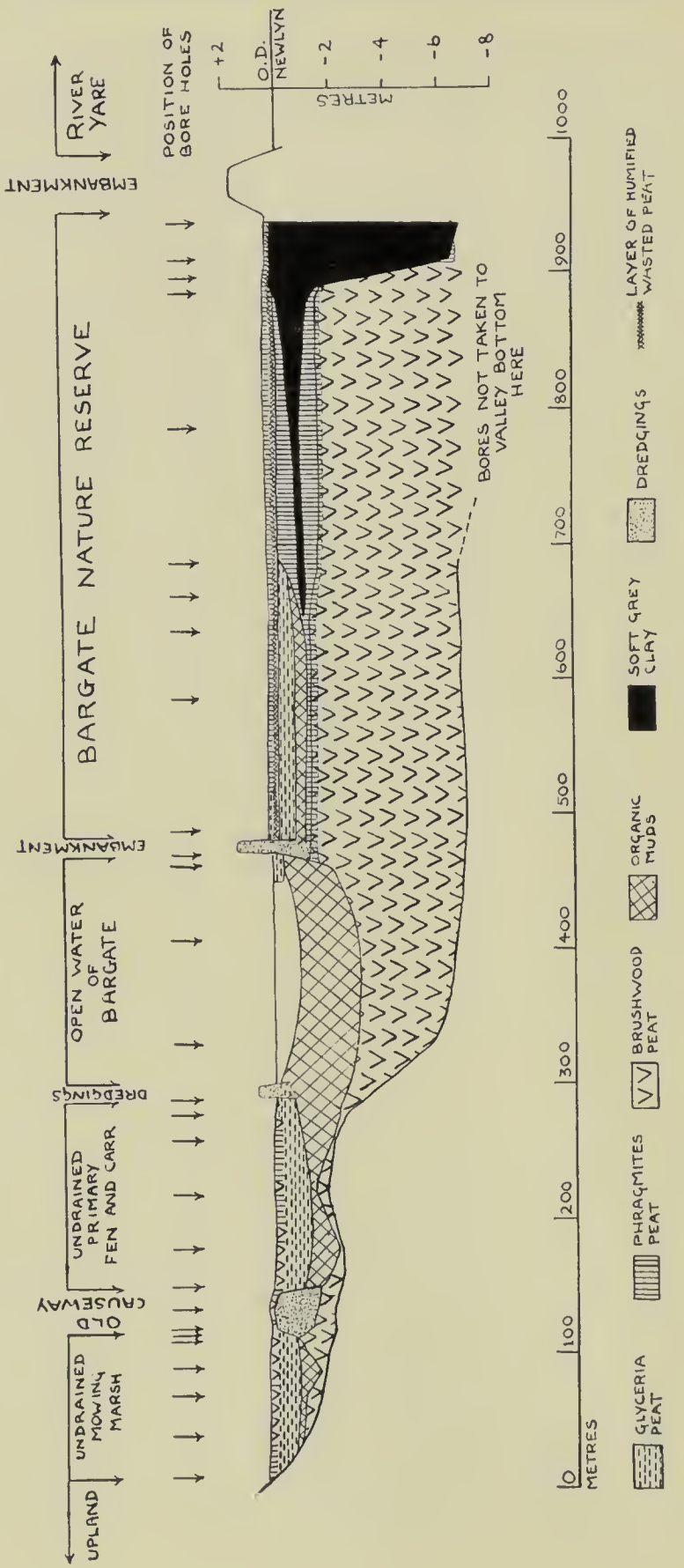


FIG. 2. The general alluvial stratigraphy in the region of the Bargate Nature Reserve.

but beneath the remaining open water of the broad, and the primary fen and mowing marsh on its south-west side, the brushwood peat is overlaid directly by organic detritus muds formed under strictly aquatic conditions. A very thin horizon of similar detritus muds stretches riverwards from Bargate half way across the Reserve, just overlapping the wafer edge of the thin clay flange extending from the deep clay channel near the river. On both sides of the broad, the muds and clay are overlain by more recently formed peats, consisting predominantly of *Glyceria* over the muds and of *Phragmites* over the clay. These peats are interrupted south-west of the broad by a mass of clay interpreted as representing the site of an old buried causeway, and banks of accumulated dredgings on either side of the broad also disturb the general sequence of deposits.

The original maximum extension of the open water is clearly indicated by the lateral limits of the organic muds. The uppermost peats of the Reserve lie partly on clay but partly also on shallow muds, and the south-west portion of this area must therefore occupy the site of former shallow water at the margin of the broad, almost certainly overgrown before the artificial embankment and drainage was begun. The peats over the deeper muds extending to the valley margin on the opposite side of the broad were never drained, and the embankment here is merely the result of sporadic dumping of dredgings from the channel through the broad, with no other obvious economic significance. The upper deposits on either side of Bargate are therefore only comparable in a very general sense, since the natural sequence of accumulation of the topmost peats must obviously have been modified in the region of the Reserve by its previous drainage history.

The detail of the surface deposits within the Reserve itself is shown on a larger scale in Fig. 3. Away from the riverward deep clay channel, the reed peat lying over the almost level brushwood surface extends upwards into the thin clay and mud deposits. Above the clay, a further horizon of pure *Phragmites* peat is found, but the muds on the Bargate side instead bear a mass of dense *Glyceria* peat, thickening towards the boundary adjacent to the present open water. This mass undoubtedly represents the period of primary colonisation of the shallow marginal muds by the sweet-grass *Glyceria maxima*

before the raising of the embankments and ensuing drainage ; it corresponds in type, if not in time, with similar colonisation shown in the primary fen on the south-west side of the broad in Fig. 2, and reflects observed conditions elsewhere in the region. The lens of hypnoid moss peat found above the muds in two of the bores (45 and 5) probably represents a moss accumulation round the reedswamp stools, as frequently seen in present vegetation.

The period of active drainage of the surface layers is represented by the presence of a remarkably level and uniform horizon of highly humified peat, formed from the wasted and decomposed residue of a considerably thicker mass. The sharp transition from the less humified peats below indicates the approximate level at which the water table was maintained during the drainage phase. The humified peat layer contains numerous particles of gravel, brick and other foreign material, concentrated in parts where old marsh tracks lie hidden, and thence spread across the fen by trampling cattle.

The upper limit of the humified horizon lies some 20—30 cm. below the present surface of the substrate, and is topped by a layer of fresher, more recently formed peat. The latter represents accumulations since the drainage was discontinued. Mixed with much living rootfelt, its composition reflects the character of the present surface vegetation, and under the present waterlogged conditions of the area as a whole, its upward growth is still continuing.

Previous destruction of the upper peats through wastage, and subsequent resumption of peat growth, must obviously affect the general surface level. An accurate determination of the latter at the bore holes was made by instrument from the Ordnance Survey bench mark on the Brundall White Horse Hotel. The general level along the section line was fairly uniform throughout, ranging from +0.33 m. to +0.51 m. O.D. Newlyn—a total difference of less than 20 cm. The average level of this surface lay below that of the undrained " mowing-marshes " above and below the Reserve on the same side of the river, with values of +0.59 to +0.62 m. O.D. just below Surlingham Ferry, and of +0.43 m. to +0.65 m. O.D. in a section made midway between the south Bargate exit and the Fleet Dyke leading to Rockland Broad ; however, it lay

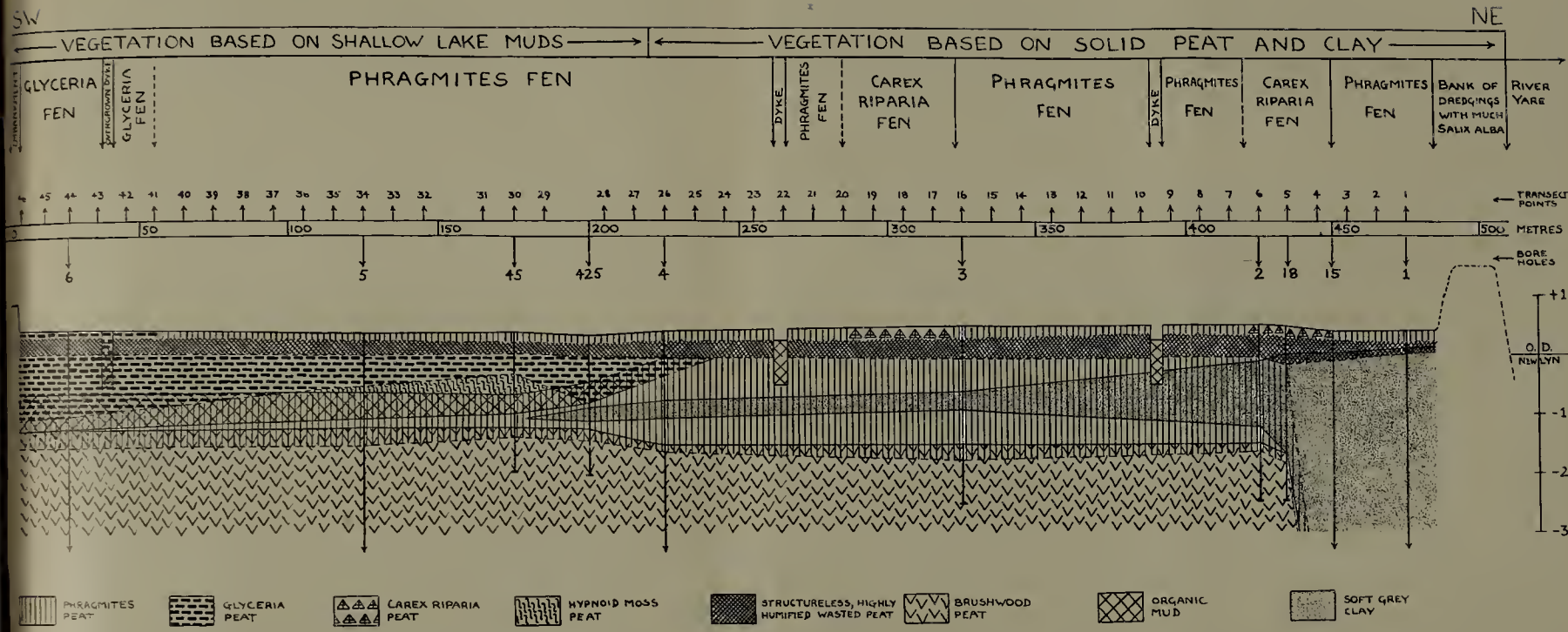
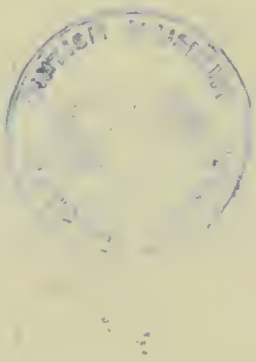


FIG. 3. Detail of the upper alluvial deposits along the section line across the Reserve.



considerably higher than the drained grazing marshes of the Rockland-Claxton Level further downstream (with surface values recorded between −0.30 m. and +0.39 m. O.D.)—a difference primarily caused by recent peat accumulation in the Bargate Reserve, and only partly due to the slight natural gradient of the river valley itself.

4. The vegetation of the area.

The main communities at present existing in the area are indicated in outline in Fig. 4. The approximate positions of the trees and bushes were plotted from the 1946 vertical air photograph, and the boundaries of the chief plant communities related to these and to the main drainage dykes by rough paced and taped measurements. In addition, a vegetation transect accompanied the section line of bores, and is superimposed in outline above the profile shown in Fig. 3. A detailed list of species was made at 10 m. intervals along the transect line, and species were also recorded from a number of metre quadrats scattered over the area as a whole.

Although the vegetation map so far constructed can but be regarded as preliminary, and indicating little more than the approximate distribution of the dominant plants, a number of interesting features have emerged. No recognisable elements of the previous pasture cover can now be found persisting in any quantity, and the Reserve is covered by a tangle of sweet-grass (*Glyceria maxima*), reed (*Phragmites communis*), and sedge (*Carex* spp.). The distribution of the first of these plants follows a very definite pattern in relation to the access of tidal water. The latter, bringing fresh supplies of mineral salts, enters the area mainly from the south, through the derelict sluice and pervious embankment ; its influence is therefore largely restricted to the southern part of the Reserve, and it is here that *Glyceria* is predominant. A recent breach in the west embankment at the end of the section line, giving free tidal access to this part as well, has allowed the spread of *Glyceria* along the western flank, where it was not recorded when the area was previously visited in 1944. Blockage by overgrowth of many of the dykes prevents free circulation of tidal water through many other parts of the area as a whole, but where such dykes remain open and in connection with the

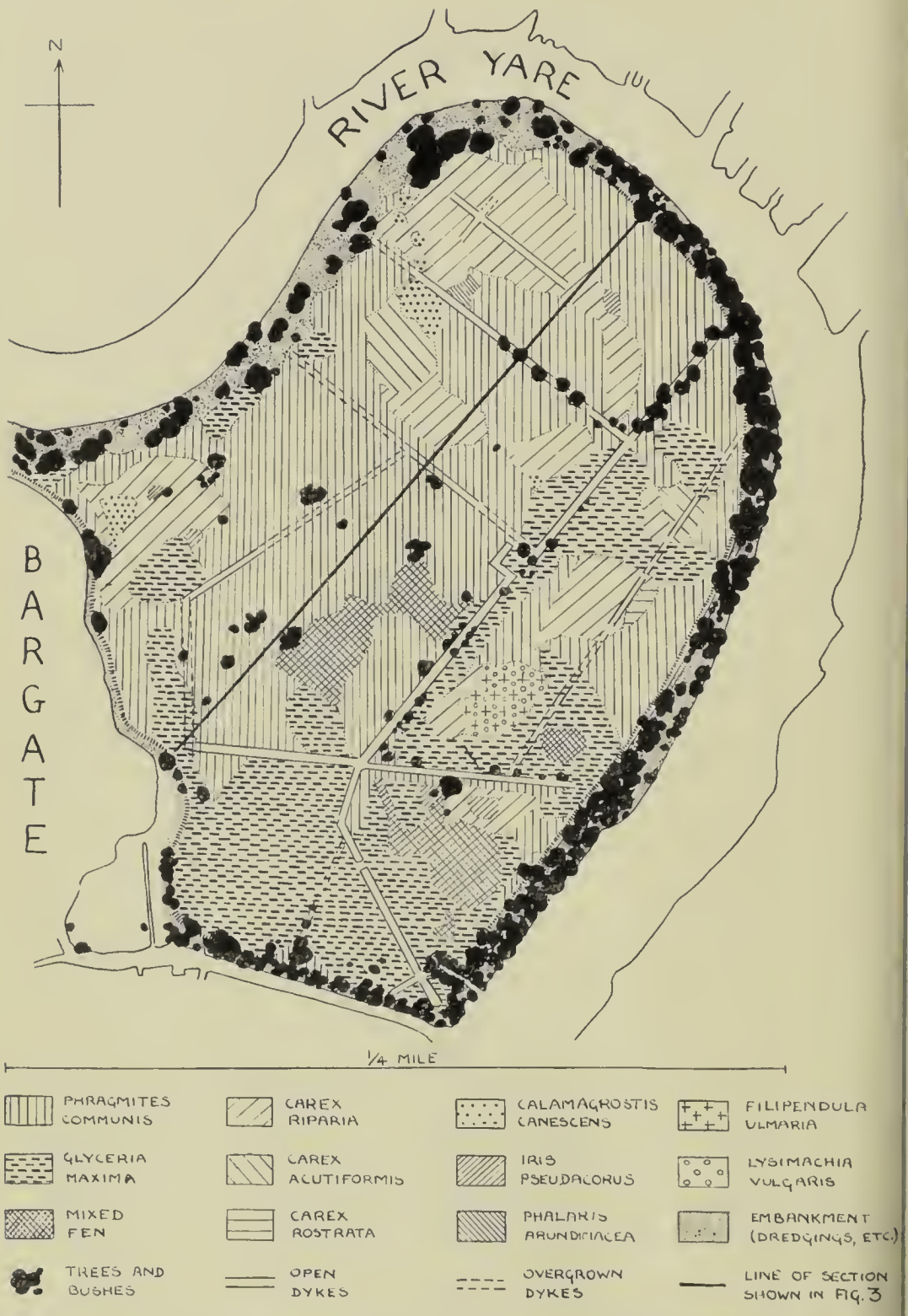


FIG. 4. Vegetation Map showing community dominants of Bargate Nature Reserve.

sluice, *Glyceria* frequently follows their general course ; two good examples of this are seen on the eastern side. Patches of *Glyceria* also occur near the north-west embankment, but their position here may probably be related to the presence of a good alternative mineral supply derived from deposited dredgings, or even from the underlying clay where this has only a thin peat cover.

Over the rest of the Reserve, *Phragmites* forms the most important dominant. It has spread considerably during recent years, with definite signs of encroachment on the large interspersed patches of sedge. The almost artificially abrupt edge frequently found where it abuts on communities of lower growth habit gives evidence of its advancing vegetative growth. Beyond the invasion line, the patches of sedge are almost free from reed ; *Carex riparia* forms the chief dominant, though *C. acutiformis* also occurs in parts.

Patches of other dominant plants are insignificant in extent and need not be considered in detail in the present paper. Some areas have no single dominant, and smaller sedges—*C. nigra*, *C. disticha*, *C. rostrata* and *C. appropinquata*—are here often mingled with other herbaceous fenland plants. *Juncus subnodulosus*, a frequent dominant on the adjacent "mowing-marshes," forms an occasional constituent of these mixed fen areas, though the latter plant has diminished greatly in the Reserve since previous observations in 1944.

As regards subsidiary species among the dominant plants, the records so far made are not sufficiently exhaustive or complete for any detailed comments to be made as yet : but in order to provide a provisional guide to the general floristic composition of the vegetation over the area as a whole, a list of all herbaceous plants recorded from the quadrats and transect points is given as an appendix to this paper.

Despite the fact that the area has long been neglected from an economic point of view, serious natural bush colonisation over the Reserve has scarcely yet begun. The wide eastern embankment is well wooded, with large white willows fringing the river course. The southern bank also bears a continuous line of trees, with alders and white willows most abundant, though the majority of the latter have been prostrated by high winds. Hawthorn and sallow also occupy the banks in

parts. In the fen itself within the bordering banks, white willows frequently form a line along the major dykes, suggesting their origin from planted stakes. The bushes in the intervening tracts chiefly consist of colonising sallow, but these are sparsely scattered. Since vigorous growth is shown by those trees which have already become established, it seems unlikely that the high water table is the major factor preventing the more widespread occurrence of colonising bushes; the density of the herbaceous cover, sporadic cutting of the reedbeds, and lack of suitable seed parents in the immediate vicinity, are probably far more potent causes of their scarcity.

5. Conclusion.

Although the former "Outmeadows" must now be regarded as an unproductive area from a strictly economic point of view, its value as a Nature Reserve is proportionately very great. Its main importance from the ecological angle lies in its interesting transitional status between the unembanked and undrained "mowing-marshes" in its vicinity, and the embanked Levels further downstream which are still drained and grazed. A clue to the difficulties of maintaining drainage and its eventual abandonment in the area is given by the stratigraphical facts. In the upstream position where the Reserve is situated, the flange of the clay wedge is very thin and only partially underlies the upper peats. The mud which occupies a roughly corresponding horizontal position towards the Bargate side may well have formed a hidden pervious layer for seepage from the broad, a difficulty not encountered in the Levels further downstream where the clay flange widens to span the whole width of the valley.

The outward signs of former intensive economic use are scarcely apparent now, and the vegetation of the Bargate Reserve is superficially similar in its floristic composition to that of the undrained fens. But despite the re-establishment of waterlogged conditions and the accompanying resumption of peat accumulation, the vegetation as a whole is by no means stabilised as yet. The very fact of its instability renders it worthy of further investigation, and the area should provide most valuable material for future biological studies from many points of view.

APPENDIX

PROVISIONAL LIST OF HERBACEOUS PLANTS RECORDED FROM THE BARGATE NATURE RESERVE (EXCLUDING THE BOUNDARY EMBANKMENTS).

Agrostis stolonifera
Angelica sylvestris
Calamagrostis canescens
Caltha palustris
Calystegia sepium
Carex acutiformis
C. appropinquata (paradoxa)
C. disticha
C. nigra (goodenovii)
C. paniculata
C. riparia
C. rostrata (ampullacea)
Cicuta virosa
Comarum palustre
Deschampsia caespitosa
Epilobium hirsutum
Equisetum limosum
E. palustre
Filipendula ulmaria
Galium palustre
Glyceria maxima
Humulus lupulus
Iris pseudacorus
Juncus subnodulosus
Lathyrus pratensis
Lemna minor
L. polyrhiza
Lotus uliginosus
Lysimachia nummularia
L. vulgaris
Lythrum salicaria
Mentha aquatica
Phalaris arundinacea
Phragmites communis
Polygonum amphibium f. terrestre
Ranunculus repens
R. sceleratus
Rumex hydrolapathum
Sium erectum
Solanum dulcamara
Stachys palustris
Thalictrum flavum
Typha latifolia
Urtica dioica
Valeriana officinalis
Vicia cracca

VI

FLORA AND FAUNA OF NORFOLK.

Miscellaneous Observations.

Compiled by E. A. Ellis.

Records of Norfolk Plants. *Coronopus didymus* (L.) Sm., Lesser Wart Cress, was found growing on the Woodbastwick bank of the river Bure at Horning Ferry, October, 1950 (J. H. Silverwood). *Teesdalia nudicaulis* (L.) R.Br., now extremely rare on the Norfolk coast, still survived on the North Denes at Gt. Yarmouth in 1950. *Myosoton aquaticum* (L.) Moench, Great Water Chickweed, was seen flowering and seeding abundantly in a stream at Wortwell, 28th September, 1950. *Hypericum montanum* L., Mountain St. John's Wort, was found by Dr. Frewen Moor near Norwich, 1950. *Impatiens parviflora* D.C., Small-flowered Balsam, was discovered growing in Wymondham, 17th June, 1950 (C. Smith). Quantities of *Melilotus alba* Medic, White Melilot, were seen at Langford, September, 1950 (R. M. Barnes.) *Agrimonia odorata* (Gouan) Mill., Fragrant Agrimony, was noticed in both wet and dry habitats in east Norfolk in 1950 (including Rockland St. Mary, marsh banks at Wheatfen Broad, road verges at Ranworth and Swannington) ; it will probably be found widespread if searched for critically. Several bushes of wild Black Currant, *Ribes nigrum* L., were barked by rabbits in a damp wood at Wheatfen in March, 1950, and it was observed that wild Red Currant bushes in the same tract of woodland were left severely alone by the rabbits. *Asperula taurina* L., an alien woodruff previously unnoticed in this county, was found well established in a damp wood at Hardingham in May, 1949 (E. Q. Bitton). *Galinsoga parviflora* Cav., Peruvian Weed, was seen flourishing in large numbers on a potato patch at Dunston, August, 1950. *Blackstonia perfoliata* (L.) Huds., Yellow-wort, was seen growing with Bee Orchis, Centaury and other plants characteristic of downlands, on boulder clay containing small limestone nodules known locally as "dodmans" in the White Earth Pit, Rockland St. Mary, in 1950. *Solanum nigrum* L., var. *chlorocarpum* Spenn, the variety of Black Nightshade which has its berries still green when ripe,

was noticed in plenty on arable land at Claxton in the autumn of 1950 (R. H. Sewell). *Naias marina* L. was found to have extended its range to Barton Broad in 1949, where Mrs. D. T. Boardman found it fruiting in a small shallow bay in September.

Caterpillars Attacking Marsh Gentian. The marsh gentian (*Gentiana pneumonanthe*) in Norfolk is restricted to a few wet heaths at the present time, having disappeared from many of its former habitats during the past century. Fortunately it is not often destroyed by insects. In September, 1950, however, I received reports from two separate sources that the well known colony on East Winch Common was being attacked by swarms of caterpillars. Most of the damage was done in the second half of August and by early September nearly all the caterpillars had vanished and doubtless pupated. On 7th September, Mrs. F. Quadling sent me one of the caterpillars, which proved to be that of the common White Ermine moth, *Spilosoma lubricipeda* (L.) (*menthastri*). These caterpillars are known to feed on a great variety of herbaceous plants and it is to be hoped that their destruction of the gentians at East Winch will prove to have been a chance affair not very likely to occur again. E.A.E.

Lettuce Rust. On 8th June, 1950, I was shown yellow clustercups on the lower leaves of half-grown lettuces of the variety "Unrivalled" on a smallholding in the Parish Pit at Rockland St. Mary, near Norwich. These in every respect appeared to be identical with the aecidia described for the rust fungus *Puccinia opizii* Bubák, not previously found on lettuces grown in Britain, but recorded by W. C. Moore in *Trans. Brit. Myc. Soc.* xxix, 254, 1947, as having been seen on lettuces imported from Holland in May, 1930, June, 1932 and May, 1946. The rust was prevalent on lettuces in market gardens and small private gardens during June, 1950 throughout an area S.E. of Norwich comprising the parishes of Bramerton, Surlingham, Rockland St. Mary, Claxton, Ashby St. Mary, Thurton, Loddon and Berghapton. Many of the plants from this district offered for sale in Norwich Market on 9th June showed heavy infection, mainly confined to the lower leaves. The clustercups appeared on at least seven named varieties, including a cos and a bronze-leaved type. I visited

the Saturday market at Gt. Yarmouth on 10th June and despite a thorough search was unable to discover a single rusted lettuce amongst the thousands exhibited on the stalls. On 12th June I found clustercups on a few lettuces growing on an allotment at Halesworth, Suffolk, and these were the only samples seen by me outside the group of parishes listed above. How the fungus came to infect crops here so suddenly has not been discovered. There was freakish weather in the affected area during May, with some heavy rainstorms and a prevalence of easterly winds over a considerable period, so that possibly a spore-cloud originating in Holland came to descend upon a part of East Anglia. *Puccinia opizii* has been shown to produce its uredospores and teleutospores on a sedge (*Carex muricata* L.) which occurs in this country, so it is possible that local colonies of this sedge were infected by aecidiospores brought on imported lettuces in the previous year, and that they in turn gave rise to the trouble amongst our own crops. A search of hedgebanks and waste places in the vicinity of ground occupied by rusted lettuces in ten Norfolk localities failed to reveal the presence of *Carex muricata* or any of the sedges most nearly related to it. A clump of *Carex muricata* (L.) (*C. pairaei* Schultz) transplanted from Arminghall to Surlingham for experiment, was very freely inoculated with fresh aecidiospores from lettuce leaves almost daily throughout the latter half of June, but no positive infection followed. One other puzzling feature of the outbreak is that although on the European mainland *Puccinia opizii* is said to attack a number of other Composites besides wild and cultivated lettuces, including nipplewort, sowthistles and hawksbeards, I could find no aecidia on *Lapsana communis*, *Sonchus asper*, *S. oleraceus*, *S. arvensis*, *Crepis capillaris* and *C. taraxacifolia* growing with rusted lettuces in Norfolk. I examined colonies of wild lettuce, *Lactuca virosa*, growing at Stockton, Gillingham and Toft Monks, in June and July, 1950, without finding the rust on their leaves.

E.A.E.

Rust Fungi (*Uredinales*). Recent finds of interest include the following:—*Puccinia arenariae* (Schum.) Wint. on berry-bearing campion (*Cucubalus baccifer*) gathered at Merton by Mr. J. Silverwood, 30th September, 1950; *Puccinia leucanthemi*

Pass. on corn marigold (*Chrysanthemum segetum*) gathered at Bodham, near Holt, by Miss R. M. Barnes, 5th October, 1949 and not previously recorded from this host plant in Britain; *Puccinia cichorii* (D.C.) Bell. on chicory (*Cichorium intybus*) at Surlingham, 17th July, 1949 and Wortwell, 28th September, 1950 (new to the Norfolk list); *Puccinia hypochaeridis* Oud., pycnia and primary uredospores, which are seldom found, on cat's-ear (*Hypochaeris radicata*) at Winterton Dunes, 6th April, 1950, and uredospores in abundance on the smooth cat's-ear (*Hypochaeris glabra*) on Scolt Head Island, 29th June, 1948; *Uredo ammophilina* Kleb. & Lind, uredospores only, on marram grass (*Ammophila arenaria*) at Winterton, 6th April, 1950, although on the previous day teleuto-spores were found in abundance on marram grass growing at the base of Minsmere cliff, Suffolk, suggesting that local climatic differences might have some influence on the behaviour of the rust in this respect; *Uredo glyceriae* Lind, on salt-marsh grass (*Puccinellia maritima*) growing beside the river Waveney on the Halvergate "island," 17th July, 1950; *Phragmidium tormentillae* Fuckel, on *Potentilla procumbens* Sibth. gathered by Miss R. M. Barnes at Bodham, 5th October, 1949; *Coleosporium senecionis* (Pers.) Fr., uredo and teleuto-spores on wall ragwort (*Senecio squalidus*) on Norwich Castle mound, 7th November, 1950 (not previously recorded from this host-plant).

E.A.E.

Leech on a Wild Duck. A half-grown specimen of the bird-leech *Protoclepsis tessellata* Müll. was found attached to the right leg of a mallard shot near Rockland Broad, 10th November, 1950.

E.A.E.

Cellar Spider. Dr. W. S. Bristowe discovered a specimen of *Physocyclus simoni* Berl., new to Norfolk, in a cellar of the Maid's Head Hotel, Norwich, 6th August, 1950. This spider is found typically in dry wine cellars.

Great Green Grasshopper. A specimen of *Tettigonia viridissima* L., a rare and local insect in Norfolk, was found at Reedham, 3rd September, 1950 (K. C. Durrant).

Imported Locusts. A large Egyptian grasshopper, *Anacridium aegyptium* (L.) was found amongst cauliflowers imported from Italy and exposed for sale at Wroxham in February, 1949; another was found with imported Brussels sprouts in Norwich at about the same date; a further specimen was taken from Italian cauliflowers at the Norfolk and Norwich Hospital in January, 1950.

Wood-Boring Beetles. A specimen of the "house longhorn," *Hylotrupes bajulus* (L.) was found in a house at Catton Grove, Norwich, 6th October, 1950 (R. M. Barnes), where it had emerged from the wood of an orange-box. Its discovery was of special interest in view of the fact that this species has become a timber pest in buildings in southern England in recent years, attacking softwoods used in roof construction. It has not yet been discovered causing trouble of this kind in Norfolk.

In September, 1949, Mr. A. B. Whittingham collected a specimen of the Tenebrionid, *Helops caeruleus* (L.) in Norwich Cathedral. It is remarkable that this rare beetle has been found living in the immediate vicinity of the Cathedral persistently for about 125 years. It was described as an inhabitant of the Lower Close by Robert Wigham in Chambers' *History of Norfolk*, 1829 and was again taken from that locality on several occasions by Norwich entomologists towards the end of the 19th century. It is not known to occur elsewhere in the county at the present time and the only other local record for it is that of the Pagets, who included it in their list of Yarmouth insects in 1834.

Poplar Sawfly. Miss N. H. Benn collected caterpillars of the sawfly *Pteronidea compressicornis* (Fabr.) on leaves of white poplar on Norwich Castle mound in July, 1950. The characteristic white projecting points of dried secretion from the mouths of the larvae were present on the leaves.

Lepidoptera. Mr. R. G. Todd contributes the following records of moths collected in Norfolk during the past three years. Pigmy Footman, *Eilema pallifrons* Zeller, Horsey, July, 1950. Buff Footman, *Eilema deplana* (Esper), about 150

attracted to the light of a mercury-vapour lamp at Wells, 2nd August, 1948. Four-spotted Footman, *Lithosia quadra* (L.), one taken at Wells, 8th August, 1950. Bulrush Wainscot, *Nonagria typhae* (Thunb.), Horsey, July, 1950. Lunar-spotted Pinion, *Cosmia pyralina* (Schiff.), one at Wells, 1948. Olive, *Zenobia subtusa* (Schiff.), two at Wells, 1948. Crescent-striped, *Hydraecia oblonga* (Haw.), Wells, 1948. Scarce Bordered Straw, *Heliothis armigera* (Huebn.), two at Wells, 30th August and 9th September, 1950. Marbled Clover, *Heliothis viriplaca* (Hufn.), five at Wells, August, 1950. Setaceous Hebrew Character, *Amathes c-nigrum* (L.), 8,000 out of 9,000 moths were of this species collected in a mercury-vapour trap at Wells between 11.30 p.m. and dawn during the night of 9th—10th September, 1950. White Point, *Leucania albipuncta* (Schiff.), single specimens were taken at Wells on 8th, 12th and 13th August, 1950. Four-spotted, *Acontia luctuosa* (Schiff.), an insect of the Breck district, was found at Wells in 1948. Clay Triple-lines, *Cosymbia trilinearia* (Borkh.), Wells, 1948. Pretty Chalk Carpet, *Melanthia procellata* (Schiff.), Wells, 1948. Gem, *Nycterosea obstipata* (Fabr.), Horsey, July, 1950. Scorched Wing, *Plagodis dolebraria* (L.), Wells, 1948. Pine Hawk Moth, *Hyloicus pinastri* (L.), one at Wells, 8th August, 1950. *Margaronia unionalis* (Huebn.), one at Wells, 9th September, 1950. *Phlyctaenia cilialis* (Huebn.), several at Horning, 1948. *Loxostege palealis* (Schiff.), at light, Horsey, July, 1950.

Death's Head Hawk Moths. The year 1950 was outstanding for the large number of *Acherontia atropos* (L.) noticed in Norfolk during the late summer and autumn. 326 were recorded from 64 different localities. No reports of the occurrance of these insects were received from the King's Lynn district, nor from anywhere in the county west of a line drawn through Docking, West Lexham and Thompson. Most of the specimens were larvae and pupae dug up in potato fields. Several larvae were reported as feeding on cabbages and some certainly continued to do so in captivity. Thirteen larvae at Thompson were taken from false tea tree (*Lycium chinense*) ; one at Brinton was found on woody nightshade (*Solanum dulcamara*) and one at Reedham on runner beans.

Most of the larvae were of the usual yellow-green form ; a few were more greenish or more yellowish than the average. Several brown larvae were found, including seven at Thompson with zig-zag stripes running lengthwise down their backs. Larvae, pupae and imagines were heard squeaking in several instances, but the squeaks were seldom repeated. Many pupae were " forced " by Norfolk entomologists, three or four weeks generally elapsing between pupation and emergence when the pupae were subjected to fairly high temperatures (70° F. and over) and a damp atmosphere. Some pupae were found to be still alive at the end of January and it remains to be seen whether there will be a natural emergence of a percentage of the moths in Spring. A summary of records supplied by members of this Society and others is given below. One imago was found at each locality marked with an asterisk.

Attleborough	...	1	*Happisburgh	...	1
Attlebridge ...	...	29	Haveringland	...	7
Aylsham ...	...	2	Hellington ...	...	1
Bale	...	1	*Hickling ...	...	1
Barford ...	...	2	Hindolveston	...	50
Barnham Broom	...	1	Hingham ...	...	1
Bawburgh ...	...	1	Holt	...	9
Besthorpe ...	...	2	Ingworth ...	...	6
*Binham ...	...	8	Kelling ...	...	1
Bodham ...	...	1	Langley ...	...	1
Bramerton ...	...	3	Lenwade ...	...	3
Brandon Parva	...	2	Long Stratton	...	1
Brinton ...	...	1	Lyng	...	1
Briston ...	...	1	Marsham ...	...	9
Bunwell ...	...	1	Martham ...	...	1
Burlingham	...	1	Mautby ...	...	4
Buxton ...	...	11	Melton Constable	...	4
Colney ...	...	6	North Tuddenham	...	1
Dickleburgh ...	...	1	Norwich ...	...	6
Docking ...	...	1	Reedham ...	...	1
East Dereham	...	2	Sculthorpe ...	...	4
East Harling	...	1	Southrepps ...	...	2
Felmingham	...	1	Stratton Strawless	...	22
Felthorpe ...	...	10	Tasburgh ...	...	1

Filby	1	Thompson	14
Foulsham	19	Wacton	1
Frettenham ...	1	Walsingham ...	1
*Gorleston	1	*Wells	31
Great Yarmouth ...	1	West Beckham ...	2
*Lightship off Yarmouth	1	West Lexham ...	1
Gressenhall	1	Weybourne	4
Griston	1	Wighton	18

(R. M. Barnes).

Convolvulus Hawk Moths. Records of 25 specimens of *Herse convolvuli* (L.) found here in 1950 are given in detail below. Whereas in the case of the Death's-head there was a preponderance of larvae and pupae, only four larvae and one pupa of the Convolvulus Hawk moth were found. Imagines captured were as follows:— 1 in Norwich, 14th August (D. Moppett) ; 1 at Thorpe, Norwich, 30th August (D. Back) ; 1 at Surlingham, 17th September (Mr. Preston) ; 1 at East Beckham, 20th September (G. Scott) ; 1, Norwich, September (Mr. Driver) ; 1 Norwich, 21st September (Mr. Disley) ; 1 at Lowestoft, on a deck chair on the beach, 5th September (M. J. Seago) ; 1 at Overstrand, 20th October (K. C. Durrant) ; 1 at Quidenham, 24th October (Lord Walsingham) ; 9 at Wells—2 at light and the rest on *Nicotiana affinis* flowers at dusk—(R. G. Todd) ; 1 on Nicotiana flowers at Brinton, 25th August, 1 at Holt, 29th August (R. P. Bagnall-Oakeley).

Two larvae were found on *Convolvulus arvensis* at Rockland St. Mary, 28th August (Miss C. Rudd) ; one of these was full-grown and brown in colour, pupating on 1st September and producing a female moth on 6th October (forced by A. R. M. Palmer) ; the other was smaller and light green, pupating on 7th September and producing a male moth on 12th October (forced by A. R. M. Palmer). Two larvae were collected at Wells (R. G. Todd) and one pupa was unearthed with potatoes near where bindweed had been growing at Holt, 10th September (R. P. Bagnall-Oakeley).

VII

OBITUARY

ROBERT GURNEY, M.A., D.Sc., F.L.S.

Robert Gurney, who died at Oxford on March 5, 1950 at the age of 70, was one of Norfolk's most distinguished naturalists. He took First Class Honours in Zoology at Oxford in 1902. Subsequently he never held any official position, but worked continuously in his private laboratory, first in Norfolk and later at Boars Hill, near Oxford. When still an undergraduate, he began to take a special interest in the Crustacea, and throughout his life he concentrated on these animals, in particular on the Decapods and Copepods. He and his brother Eustace founded at Sutton Broad the first freshwater biological laboratory in Britain. In addition to all his work in this country, he travelled and collected in Algeria, Tunis, the Red Sea and Bermuda. Between 1906 and 1942 a number of articles and monographs written by Robert Gurney on his special subjects were published by the Ray Society and in scientific journals. He wrote also for the general reader in the *Illustrated London News*, and in a small book " Our Trees and Woodlands," illustrated with his own clear and attractive drawings. He assisted Miss E. L. Turner in her book on Broadland Birds published in 1924.

Although a specialist, his knowledge both of zoology and botany was wide thorough and minute, and to accompany him round his broad at Calthorpe or anywhere else in the country was a lesson in the art of intricate study. He was boyishly keen, found something of interest everywhere, and was constantly making discoveries that other eyes would have missed.

He was always at work, patiently and happily pursuing his scientific enquires in his private laboratory, modest and cautious in his suggestions, questioning everything and reluctant to form definite conclusions. He was like that in private life—shy and retiring, but eager in pursuit of knowledge and delighting in the company of those who shared his tastes.

He was keenly interested in the Castle Museum, and gave valuable assistance in the organization of its natural history exhibits. He was President of the Norfolk and Norwich Naturalists' Society in 1912–13, serving also as Treasurer and Editor of Transactions. He and his wife were active in the Boy Scout movement, and he was constantly encouraging the younger generation to a fuller knowledge and appreciation of the country and of their duties as citizens.

MR. A. J. RUDD, O.B.E., F.Z.S.

Mr. A. J. Rudd who died at his home in Norwich, aged 86, on 22nd December 1950, had for many years been a familiar figure in Norwich and on the Broads. A man of wide interests, throughout his long life he devoted much of his time, both as a study and a recreation to the various aspects of Broadland sport and natural history: a keen fisherman, he was more particularly interested in fish, molluscs and other water fauna, on all of which he was an accepted authority. He was a good friend, with a shrewd and kindly sense of humour and an enquiring mind; as a naturalist, he was observant, patient and methodical and these qualities, coupled with his long experience made his knowledge on the subject of his choice profound. He was a friend and contemporary of the late Mr. Arthur Patterson, Mr. Christopher Davies and a host of other men, who left their mark in Broadland natural history. He delighted to recall the Broads as he knew them at the turn of the century, and it seems incredible to most of us that such vast changes should occur in 50 years.

A native of Norwich, where he lived all his life, he was formerly in business there as a well known sports outfitter, but latterly he was even better known as Clerk to the Norfolk Fishery Board, a post that he held for 38 years. For many years a Fellow of the Zoological Society, he joined the Norfolk and Norwich Naturalists Society in 1918 and was President in 1942–43. In 1949 he was awarded the O.B.E. in recognition of his great contribution to angling interests in Norfolk. He led an active public life, was a valued member of the Broads Investigation Committee, and upon his resignation from the

Fishery Board, necessitated through failing health in March 1950 he was made an honorary member of the Freshwater Biological Association. He maintained his life interests to the end, and was at the time of his death collecting and arranging his notes with a view to publication.

E. Q. B.

CHARLES CHESTNEY.

No obituary of Charles Chestney, late Warden of Scolt Island, is included here, because reference to him is made on the first page of the Wild Bird Protection Report for 1950.

MEMBERSHIP.

Candidates for ordinary membership may be nominated and elected at any meeting of the Society ; three dissentient votes shall exclude a candidate.

The annual subscription is ten shillings, payable on election or at the beginning of each financial year (April 1st) to the Hon. Treasurer, D. A. P. Gould, 8, Upper King Street, Norwich, who will supply a banker's order form for this purpose on request. Members may instead pay a life composition fee of £8.

Every member is entitled to receive one copy of the *Transactions* as published annually ; to attend the meetings and excursions and to make use of the Society's library. Members may bring friends to meetings.

Enquiries should be addressed to the Hon. Secretary, E. A. Ellis, Castle Museum, Norwich, to whom also applications should be made for back numbers of the *Transactions*.

MATERIAL FOR PUBLICATION.

The Hon. Editor will be glad to consider papers, preferably on Norfolk natural history, for the *Transactions*. These should aim at clarity of expression and should be typewritten. Such contributions should reach the editor by the end of September. The cost of a reasonable number of illustrations will be borne by the Society, but where great expense is likely to be incurred it is hoped that authors will endeavour to share the cost, by obtaining grants or otherwise. Authors receive 25 off-prints of their papers free and further copies may be ordered in advance either through the Hon. Secretary or the Soman-Wherry Press Ltd., Heigham Street, Norwich, from whom an estimate of the cost can be obtained.

CHANGE OF ADDRESS.

Prompt notification of members' changes of address will greatly facilitate the work of the officers of the Society.

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OF THE

Norfolk and Norwich

NATURALISTS' SOCIETY

FOR THE YEAR

1951

VOL. XVII PART III.

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FEBRUARY, 1952

PRICE 10/-

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TRANSACTIONS

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NORFOLK AND NORWICH NATURALISTS' SOCIETY.

Income and Expenditure Account for the year ended 31st March, 1951.

1950	Expenditure.	£ s. d.	£ s. d.	1950	Income.	£ s. d.
155	To Cost of Transactions		166 12 6	191	By Subscriptions—Annual	191 10 9
	,, General Expenses			8	Life	— — —
34	Postage, Printing and Stationery, ...	50 7 0		1	,, Sale of Publications	3 17 6
12	Library Rent	6 5 0		30	,, Interest and Dividends	29 12 6
7	Cost of Lectures and Excursions ...	22 15 0		—	,, Excess of Expenditure over Income	51 13 1
2	Subscriptions to Scientific Societies...	2 12 6				
5	Research Committee and Geological Research	17 0 0				
6	Sundries	3 10 5				
			102 9 11			
9	,, Depreciation of Office Equipment ...		7 11 5			
230			£276 13 10	230		£276 13 10

BALANCE SHEET as at 31st March, 1951.

	Liabilities.	£ s. d.	£ s. d.		Assets.	£ s. d.
766	Amalgamated Funds, 31st March, 1950	766 4 1		1	Subscriptions due	10 0 0
—	Excess of Expenditure over Income this year	51 13 1		723	Investments	723 5 5
			714 11 0	206	East Anglian Trustee Savings Bank... ...	210 15 2
40	Subscriptions in Advance		33 0 0		Office Equipment at cost ... 37 6 2	
151	Barclays Bank		216 9 7	27	*Less* Aggregate Depreciation to date 17 6 2	
						20 0 0
957			£964 0 7	957		£964 0 7

Audited and found correct,
H. W. BACK,
18th April, 1951.

I

HON. SECRETARY'S REPORT, 1950—51

ORDINARY meetings of the society were held at Norwich Castle Museum (with one exception) on Saturday afternoons as follows :

OCTOBER 21ST, 1950 : exhibition of specimens and contribution of notes made by members during the previous summer. Miss D. M. Easter, Miss P. Gillespie, Miss J. A. Stockings, Miss I. Goff, Messrs. K. J. Allison, S. E. Glendenning, D. Hurr, L. M. McEwen, F. E. Muskett, P. Palmer, J. F. Peake, D. Punter, H. Riley, C. Smith, E. J. Smith, M. E. Smith, P. E. Briggs, P. Thrower, R. W. Turner, J. Vaughan and W. Woodrow were elected members of the society.

NOVEMBER 18TH : Mr. K. C. Durrant gave a talk and demonstration on methods of collecting and preserving insects. Miss Feetham and Miss K. E. Segger were elected members of the society.

DECEMBER 16TH : Mr. R. E. J. Goodman, plant pathologist at H.M. Flax Establishment, lectured on the fungal diseases of Flax in the British Isles, with a fine series of photographs and both living and preserved specimens.

JANUARY 20TH, 1951 : Mr. John Sankey described experiences with tame badgers, foxes and other animals, illustrating his talk with lantern slides and a film. Mrs. Suffling, the Misses A. and B. Suffling, Miss P. E. Blake, Miss K. Osborne, Mr. and Mrs. T. C. Wyatt and Mr. E. Crickmore were elected members of the society.

FEBRUARY 22ND : Major A. Buxton showed his films of red deer, roe, black-cock, capercaillie, otter, harriers, turtle dove, etc., at the Noverre Cinema.

FEBRUARY 24TH : Mr. Walter Higham showed his colour-film entitled " Land of the Flamingo." Miss C. Scoones, Miss M. B. Unthank, Capt. J. F. Rippingall, Dr. R. G. Ticehurst, Messrs. H. C. Emms, C. E. J. Moore, A. G. Hodges, J. J. Coltart, T. W. Irvine and Col. F. E. D. Drake Briscoe were elected members of the society.

March 17th : Mr. H. J. Howard gave a lecture entitled " Spiderland " with lantern illustrations. Mrs. C. W. Ratcliff was elected a member of the society.

The 82nd Annual Meeting was held at Norwich Castle Museum on April 21st, 1951, when the Presidential Address, entitled " Norfolk Geology, from the coming of Man " was delivered by Mr. J. E. Sainty, B.Sc. The Hon. Treasurer presented the audited accounts for the year ending March 31st, 1951, which showed an excess of expenditure over income during the year of £51 13s. 1d. It was resolved by majority vote that the annual subscription should be raised to 15s. and the life composition fee to £12 as from April 1st, 1952. Further amendments of the Rules were made as follows : Section III, Clause 3 to read " The Officers of the Society shall be a President, President-elect, Vice-Presidents, Secretary, Treasurer, Auditor and Editor, all to be elected by show of hands yearly at the Annual Meeting and all to be eligible for re-election." Section V to read " The Society shall sponsor an annual publication under the title of " The Transactions of the Norfolk and Norwich Naturalists' Society.' Responsibility for this publication shall be vested in an Editor and Sub-Editor." It was also resolved that the Editor be empowered to appoint his own sub-editor

The following officers were elected to serve in 1951—52 : President, Dr. J. M. Lambert ; President-elect, R. P. Bagnall-Oakeley ; Vice-Presidents, Major A. Buxton, Professor Oliver, Professor Steers, Messrs. B. B. Riviere and H. J. Howard ; Treasurer, D. A. P. Gould ; Auditor, H. W. Back ; Secretary, Miss N. H. Benn ; Editor, E. A. Ellis. Miss Buttery, Messrs. J. E. Sainty and K. C. Durrant were elected to serve on the Committee for three years.

Mrs. Cartwright, Miss M. Rust, Messrs. W. B. Emms, G. O. Gibbons, W. W. R. Giles, R. H. Sewell were elected members of the society.

The President tendered the Society's thanks to Major A. Buxton for all the work he had put in during his editorship of the Transactions in the past fifteen years.

II

PRESIDENT'S ADDRESS

Delivered by J. E. Sainty, B.Sc. to members of the Norfolk and Norwich Naturalists' Society at the Castle Museum, Norwich, April 21st, 1951.

THE GEOLOGY OF NORFOLK.

With special reference to the Pleistocene period.

The Norwich Geological Society was founded in 1864 with the Rev. John Gunn as President, and during the twenty years of its existence over four hundred articles were published dealing directly with, or referring to, the geology of the county. The interest of the leading scientists of the country was attracted and many of the foremost geologists of the day visited the city with the British Association in 1868. The Officers of the Geological Survey, at work here around 1880, paid warm tribute to the assistance they received from the local enthusiasts, but, when their work was completed, and it appeared that the foundations of the study of Norfolk geology were truly laid, the Norwich Geological Society was amalgamated with the Norfolk and Norwich Naturalists' Society and a period of almost complete stagnation in local geological studies ensued.

The last of the Norfolk Memoirs appeared in 1883, but though the pre-glacial strata had raised few difficulties, the overlying glacial deposits presented problems of extreme complexity. H. B. Woodward (1881, 4) in the Norwich Memoir, " found that owing to the variable nature of the beds, the several local divisions, made out in certain ' typical ' sections, were not persistent and could not be laid down on the map. Moreover, the very fact of this uncertainty in tracing out and correlating minute divisions has led to considerable diversity of opinion among geological writers." This was hardly surprising, since boulder clays, mostly more or less chalky, brickearths, non-fossiliferous pebble beds, and sands which might or might not contain marine shells, with ever-varying sections, often exceedingly contorted and changing in detail as the profiles cut back, caused confusion on the borders where

different officers were working, and tended to make chaos of the mapping. Looking back from the standpoint of to-day, it is easy to appreciate not only the complexity of the situation but also how much the orthodox views hindered any possibility of disentangling the confusion. The accepted idea of the " Great Ice Age " was that it was a single complete episode in which the ice sheets, accumulating on the Scandinavian plateau and the mountains of the north, pressed southwards to the edge of the Thames valley and then, after halting, slowly melted back and finally disappeared. The complexity of the deposits could be explained as due to the varying pressures and inter-glacier movement of the streams of ice coming from different gathering centres—Scandinavia, the Cheviots, the Pennines, etc. This assumption explained the variety of rocks brought by the ice sheets, since many of them were easily identifiable and their sources of origin recognised. Thus Shap granite, Carboniferous limestone and Scandinavian rhomb-porphyry could clearly not have been brought to Norfolk by the same ice-flow. A direct corollary of the theory of the single ice episode was that the appearance of man in Britain north of the Thames was post-glacial, for it was obviously impossible that he could have lived here whilst the land was hidden by a tremendous ice covering, and no-one had seriously suggested that man existed before the Ice Age. However, there were some sceptics—James Geikie considered that the single ice sheet failed utterly to cover the observed phenomena and suggested no less than seven successive ice advances, while Skertchly (1877) insisted that in the Fen borders he was finding humanly worked flint implements below and among glacial deposits. Geikie received little support, and Skertchly's unorthodox views led to his leaving the Survey.

However, from the involved discussions, certain ideas had emerged on which all the officers agreed. The lowest glacial deposit of the North Norfolk cliffs (the Cromer Till) and the Norwich Brick-earth both contained unmistakable Scandinavian rocks, and since these must obviously have been carried across the North Sea basin, whether by floating bergs or by actual ice sheet, these deposits were distinguished as " North Sea Drift " and were explained as the result of the Scandinavian ice reaching the area in force before the British ice had attained

sufficient weight to press it off. The Chalky Boulder Clays and the deposits encountered with them were explained as products of the British ice sheet. All agreed that, since the river valleys of central Norfolk had been cut down through the Norwich Brick-earth whilst the Chalky Boulder Clay had flowed down into them, there had been some period of erosion between the two. The " purple " boulder clay of the Hunstanton region had not been recognised inland and was considered the last product of the melting ice sheet, whilst the coarse gravel capping the cliffs at West Runton, which had in 1878 yielded a hand axe to a Cromer schoolboy, A. C. Savin, was considered accordingly post-glacial, and, though occupying the very top of the cliff, was mapped as " valley gravel."

For a generation, little progress was made ; the attempts to reconcile the discrepancies proving so little successful that the Norfolk sections gained the description of " the grave of geological reputations." However, early in the new century fresh ideas were stirring. In 1908 W. G. Clarke's foundation of the Prehistoric Society of East Anglia led to renewed investigations of the gravel pits and boulder clays, though the geologists were far from accepting Dr. Sturge's dictum that the " paleoliths were the fossils of the Pleistocene," and the claims of Clarke and Reid Moir to have discovered humanly struck flakes in the sub-crag stone bed were being hotly debated. In the following year Penck and Brückner published the evidence obtained by their researches in the Austrian Alps of " interglacial " deposits, with vegetation and animal life occurring between distinct ice advances, so necessitating re-examination of the evidence for the uniglacial theory here. When in 1910 Harmer published in these Transactions, " The Glacial Deposits of Norfolk and Suffolk," he stated, " The view taken in this paper is that the glacial deposits of Norfolk were due in the first instance to the invasion of the county by the western edge of an enormous ice-sheet like that of Greenland, which, originating on the Scandinavian uplands, then standing in all probability at a higher level, filled the basin of the North Sea and overspread, in the opinion of most of our best authorities, the plains of Northern Europe. At a later stage of the Pleistocene epoch however, the North Sea ice retreated from East Anglia and there are no indications that it ever re-appeared.

Subsequently, and apparently separated from the earlier glaciation by a considerable interval, the district was invaded by an inland ice stream from the north-west, for which in 1904 I proposed the name of the 'Great Eastern Glacier.'"

He continued, "These facts point to the conclusion that while the brick-earths of the south represent the 'moraine profonde' of the great Scandinavian glacier, levelled as by a gigantic steam roller, the Cromer ridge, piled up and contorted by the pressure of the ice and attaining in places a height of 300 feet above sea level, indicates its terminal moraine, not at the period of maximum extension but at some stage, possibly a prolonged one, of its retreat." He concludes, "The coast ridge is therefore newer than the Norwich Brick-earth." Later he adds, "After some interval, during which the deposition of sand and the erosion of the valleys took place, possibly representing one of the interglacial periods insisted on by Professors James Geikie and Penck, Norfolk was again invaded by ice, by the great inland glacier to which was due the well-known Chalky Boulder Clay, a wide-spread deposit, the *moraine profonde* of the second glaciation which covers a great part of Norfolk and Suffolk with a more or less continuous sheet." Thus two ice sheets separated by a distinct interglacial were by now admitted as probable.

The outbreak of war interrupted progress, and it was some time before research on the deposits could be resumed. In 1923 Professor P. G. H. Boswell prepared for the Geologists' Association an account of "The Geology of the Country around Cromer and Norwich." and he summarised the state of knowledge at the time. "The area has at least four claims to geological distinction in the presence of (1) the highest beds of the Chalk known in the British Isles, consisting of the zone of *Ostrea lunata* and the uppermost part of that of *Belemnitella mucronata* (2) the most complete series of Upper Pliocene and Lower Pleistocene deposits in Western Europe (3) in all probability the most complete sequence of glacial deposits in Britain (although it has not yet been worked out in detail) and (4) the unique ridge of Drift materials exhibited in the cliff sections which cut across it." "The geological sequence exposed in the district is as follows :—

Recent	Alluvium, blown sand, shingle, etc.	
Pleistocene	Post glacial river terraces, gravels, sands and loams.	
	Cannon-shot and glacifluvial gravels.	
	Chalky Boulder Clay.	
	Glacial sands, gravels and brick-earths.	
	North Sea Drift (Cromer Till, Contorted Drift and Norwich Brick-earth.	
	Arctic Freshwater Bed.	
	Westleton Shingle.	
Pliocene	*Leda myalis* Bed.	
	Upper Freshwater Bed	Cromer Forest Bed.
	Forest Bed (estuarine)	
	Lower Freshwater Bed	
	Weybourne Crag	Icenian.
	Chillesford Crag	
	Norwich Crag	
Upper Chalk	Zone of *Ostrea lunata*.	
	,, ,, *Belemnitella mucronata*.	
	,, ,, *Actinocamax quadratus*.	

Eocene beds rest upon the Chalk in the eastern part of the district but they are covered by a considerable thickness of later beds and are nowhere exposed."

In the preceding year the writer had found in the Till at Sidestrand a Lower Paleolithic hand axe, but its significance as evidence for Cromer Forest Bed man had not yet been admitted (see Moir, 1923). Boswell and Moir were about to begin the series of investigations on the famous Hoxne deposits just over the Suffolk border, which were strongly to reinforce the evidence for interglacial occupation by man, whilst Boswell had already begun the revision of the Memoirs of the Geological Survey for Suffolk, utilising the method of microscopic analysis of heavy mineral residues, which promised to make it possible to distinguish between, and to classify, the non-fossiliferous gravels. It was at this psychological moment that H. H. Halls and I found in the Yare valley on the border of Whitlingham what Boswell described as "a wonderful series of implements certainly unique for Britain and possibly for Western Europe," and he

came in person to investigate the geology of the site. His enthusiasm and energy urged us on to examine all the gravel pits and sections within the area, and he kept to the utmost his promise to come to our aid whenever we were puzzled. In 1927 I carried out a series of investigations of the Stone Bed below the Norwich and Weybourne Crags in various areas round Norwich and on the coast (Sainty, 1929). It was whilst working on the coast sections that I had the privilege of introducing to him J. D. Solomon at that time a Cambridge undergraduate, a meeting of the utmost importance for Norfolk geology, for Dr. Solomon later devoted himself to a research on the coastal glacial deposits, a research carried out in Professor Boswell's laboratory at the Imperial College of Science. Whilst he was engaged on this work Professor Boswell published " The Stratigraphy of the Glacial Deposits of East Anglia in Relation to Early Man " in 1931, correlating the evidence from Norfolk with that from Suffolk and comparing the results of researches in other areas. He concluded (Boswell, 1931) " On stratigraphical evidence we now have good reason for the belief that four glacial episodes affected East Anglia, each represented by well marked deposits of boulder clay :—

(a) The Norwich Brick-earth (part of the Scandinavian Drift)
(b) The Chalky-Jurassic Boulder Clay (Older British Drift)
(c) The Upper Chalky Boulder Clay (Older British Drift ?)
(d) The Brown Boulder Clay of Hunstanton, etc. (possibly equivalent to the Newer Drift)

He added, " The introduction of a glacial episode before that of the Norwich Brick-earth in order to account for the falling temperature of the Pliocene seas has been shown to be unjustified by the evidence. Furthermore, it would make the glaciation in East Anglia fivefold. The correlation with the Alpine glacial episodes would then become even more difficult." Penck and Brückner's Alpine sequence of four well recognised ice sheets named after the valleys where their respective deposits were best represented—Günz, Mindel, Riss and Würm—had by now been widely accepted, and already attempts were being made to relate the English deposits to the Alpine.

Early in 1932 Dr. Solomon published " The Glacial Succession on the North Norfolk Coast," stating (Solomon, 1932a,

244) "The methods adopted depend largely on field observation; heavy mineral analysis has also been used, not so much to effect horizontal correlation as to confirm or controvert apparent breaks or changes in the vertical succession as determined by the field evidence." Dr. Slater had been plotting the glacial tectonics and his work, as well as the evidence supplied by the paleoliths, was used to check Solomons' results. The succession recognised was :—

Hessle	... H	12	Brown Boulder Clay
Little Eastern ...	... L	11	Cromer Ridge Gravels
		10	Sandy Brick-earths
interglacial ...	... *i*	9	Bacton Valley Gravel
Chalky or Great Eastern	C	8	Chalky Outwash Sand & Gravel
		7	Chalky Boulder Clay
		6	Sands
North Sea ...	... N	5	Laminated Clays
		4	Sands and Clays
		3	Upper Till
		2	Mundesley Sands
		1	Lower Till

The whole of the deposits were considered as the relics of four separate ice sheets. No direct contact was possible with Penck and Brückner's Alpine results, and the indirect comparison via the Thames Valley and Northern French deposits presented considerable difficulties. The discrepancies in the implement evidence led to the realisation that the simple French sequence of paleolithic cultures was quite inadequate and various complicated developments were suggested. Later in 1932 Boswell addressed the British Association at York on "The Contacts of Geology; The Ice Age and Early Man in Britain." He discussed the archaeological difficulties and stated (Boswell, 1932), "I should be inclined to regard the Cromer Till and Great Chalky Boulder Clay as contemporaneous, but Dr. Solomon prefers to follow Harmer in grouping the Cromer Till with the Norwich Brick-earth." He emphasised that "The correlation of the Cromer Moraine with the Norwich Brick-earth cannot be maintained on the geological evidence and breaks down entirely when the archaeological succession is taken into

account," and added, " In the present state of our knowledge we cannot consider the Upper Chalky Drift in East Anglia to be due to a major glaciation of the same intensity as those that produced the Norwich Brick-earth and the Great Chalky Boulder Clay respectively."

In 1935 the visit of the British Association to Norwich and the various field excursions associated with it attracted a wide attendance of British and European geologists and for this visit Professor Boswell prepared a fresh account of the " Geology of the Norwich District," assembling and summarising the evidence available. He stated (Boswell, 1935, 55), " The wonderful series of glacial deposits—probably the most complete in Britain—has been the subject of much re-investigation in recent years," and his paper must necessarily be the foundation for any modern account. In 1937 C. P. Chatwin wrote for the Department of Scientific and Industrial Research, " British Regional Geology, East Anglia and Adjoining Areas," particularly valuable as showing the relation of our own deposits with the midland region. Like most later work he utilised Solomon's sequence as a ground plan. Since then Reid Moir and D. Baden-Powell (1938a & b) have reported the finding of worked flints with marine shells in the Runton (Corton) Sands, Solomon : N 4 or 5, suggesting " a succession of beach deposits piled up to a height of at least 80 feet above sea level." They pointed out that " there are in fact two ' Ridge Gravels.' It is the later gravel which spreads westward towards Holt, Blakeney and Kelling and which agrees most typically with the old Norfolk description of ' Cannon Shot Gravel.' " It is this gravel which occurs as a veneer on the top and sides of the Cromer Ridge. T. T. Paterson, investigating the Brecks, distinguishes three boulder clays, all chalky. The lowest contained Scandinavian material and enabled his deposits to be related to Solomon's three earlier ice sheets, since the Hessle boulder clay had nowhere been detected inland of the Ridge. More recently Baden-Powell in " The Chalky Boulder Clays of Norfolk and Suffolk " has emphasised the distinction between the Great Eastern, so well represented in mid-Norfolk and Lowestoft, and the Upper or Little Eastern, best examined near Ipswich, and has studied in detail the direction of ice movement in each case. A. Q. Watson and the writer found Hessle boulder clay

in a road cutting above Stiffkey at a higher ground level than it had previously been recorded and the nature of the deposit was confirmed by Professors Boswell and Zeuner.

In 1948 the International Geological Congress met in London and appointed a Commission to consider the hotly debated question of the Pliocene-Pleistocene boundary. The Commission agreed that a type area should be selected where " the boundary could be drawn in accordance with stratigraphical principles ; that the boundary should be based on changes in marine faunas ; and that the classic Italian area would serve best." The definite recommendation was made (1950 *Rep. Int. Geol. Congr.* ix, 6), that " the Lower Pleistocene should include as its basal member in the type area the Calabrian formation (marine), together with its terrestrial (continental) equivalent, the Villafranchian, and noted that this usage would place the boundary at the horizon of the first indication of climatic deterioration in the Italian succession."

The application of these decisions to the classification of East Anglian strata has led to varying suggestions which would recognise the Pleistocene boundary at horizons ranging from the bottom to the top of the Suffolk Red Crag. These suggestions have been examined by Professor Boswell in a paper shortly to be published, in which he strongly advocates the unconformity between the Coralline and Red Crags. In any case it is apparent that the whole of the Norfolk Crag deposits will now be classified as Pleistocene, a decision acceptable not only to the geologists, but also to the palaeontologists and prehistorians.

Before a detailed description is given of the Norfolk deposits, Professor Boswell's remarks on the present situation must be mentioned. " One has to record with regret that field evidence in East Anglia is now considerably less than it was half a century ago ; since then the exposures have been steadily deteriorating and, indeed disappearing entirely." (see Boswell, 1952).

The Pre-Pleistocene Deposits.

For the sake of completeness the pre-Pleistocene deposits may be briefly mentioned. They comprise in downward sequence :—

Ostrea lunata Chalk	Maestrichtian
White Chalk	Senonian, Turonian, Cenomanian
Red Chalk	Albian
Carstone (Lower Greensand) ...	Aptian
Snettisham Clay	Neocomian
Sandringham Sands	Neocomian
Kimmeridge Clay	Jurassic

The strata older than the chalk are exposed in Norfolk only in the extreme west.

The Kimmeridge Clay forms a discontinuous outcrop on the Fen border as a narrow strip from Hilgay to just north of King's Lynn. It was evidently laid down as a muddy sediment in a shallow sea; marine reptiles and fish remains occur freely but the ammonites are the best known fossils. It forms the chief constituent of the Chalky Jurassic Boulder Clays. The clay has been used for brick-making; the bituminous nature of the higher portion led to the hope that oil might be found and deep boring was carried out but the results were not encouraging.

The Sandringham Sands contain few and fragmentary fossils and appear to be current bedded probably under estuarine conditions. Near King's Lynn they are pure enough to be used for glassmaking. The light, almost sterile sands have been successfully planted with trees, particularly around the royal estate.

The Snettisham Clay is used for brick-making. It contains bivalve shells, together with the ammonoid *Paracrioceras occultum* (Seeley), which shows that this clay was deposited before the Lower Greensand of southern England.

The Carstone includes sandy deposits as well as the "ginger bread" stone, extensively quarried for building; easily worked when freshly quarried, it hardens with exposure and is freely used in West Norfolk Churches and Halls. At the base are concretionary and phosphatic nodules. The fossils include ammonites, suggesting that the sea occupying southern England had spread across the Midlands and connected with

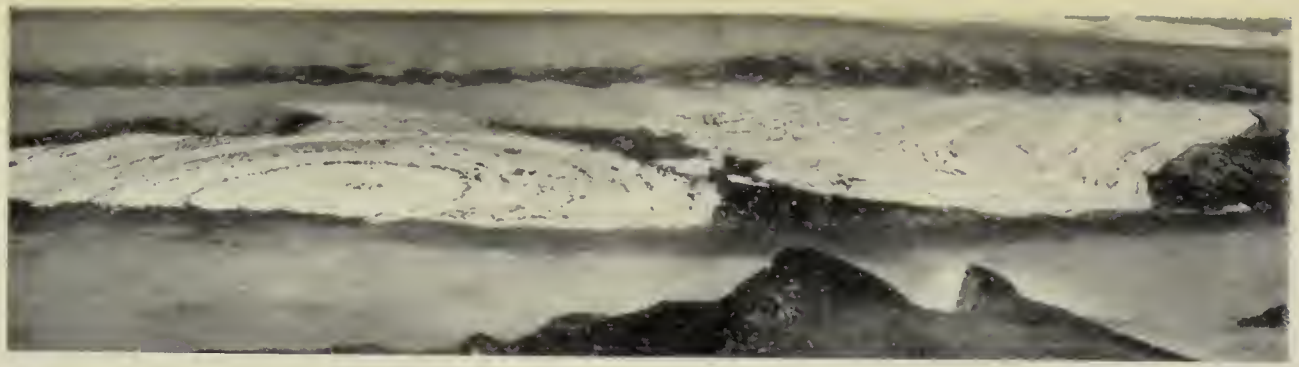
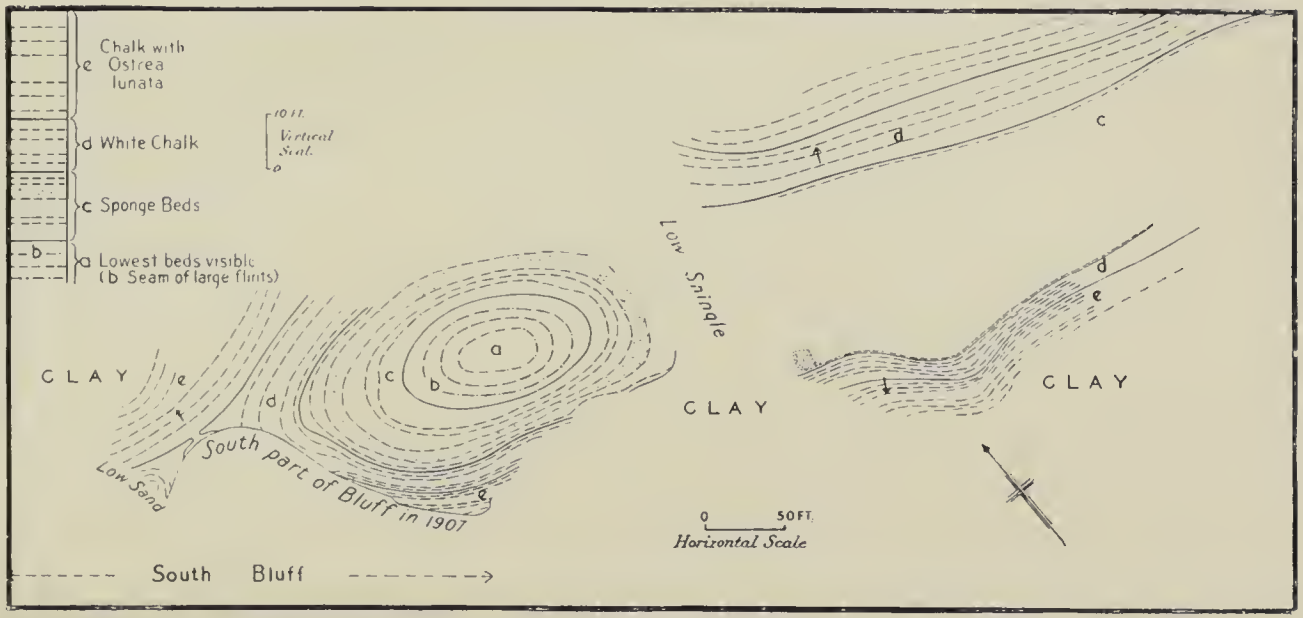


Photo: Hallam Ashley

A. Trimingham Foreshore at low tide in August, 1939, showing dome and anticline in *Ostrea lunata* Chalk.



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B. Map of Chalk outcropping on Trimingham Foreshore in 1907. After Brydone, 1908.

the sea lying to the north. The bed is coarse and pebbly at Hunstanton but becomes finer grained as it is traced towards Downham Market.

The Red Chalk or Hunstanton Red Rock is exposed in the cliffs at Hunstanton between the brown carstone and the overlying white chalk and has a striking scenic effect. It is the local equivalent of the Gault Clay. The mineral assemblages show the gradual continuous passage from the brown carstone to the red rock but the fossils show no continuity, being similar to those of the Gault, ammonites and belemnites with Inoceramus. Three bands have been distinguished—the lowest, deep red and gritty and containing quartz pebbles; the middle of rough nodular limestone; and the top, light red and mottled limestone.

The Chalk.

This forms the "bed rock" of Norfolk, attaining a maximum thickness of 1,400 feet. The general dip is roughly easterly, so that the oldest zones crop out on the west.

The Lower Chalk is without flints, the silica being distributed throughout, rendering it hard. Known locally as "clunch," and used as a building stone, though it needs protection from rain and frost; it has been used for sculpture, as in the recumbent effigy of Sir Oliver de Ingham at Ingham. At Ringstead the Lower Chalk produces some miniature downland scenery.

The Middle Chalk is exposed in shallow workings in West Norfolk. A typical fossil of the zone is *Terebratulina lata*. *Rhynchonella cuvieri* is found near Sedgeford Church, and *Terebratula gracilis* at Hillington, Flitcham and Fring. The famous Brandon-Grimes Graves flint occurs near the top of the Middle Chalk.

The zones of the Upper Chalk :—

Ostrea lunata
Belemnitella mucronata
Actinocamax quadratus
Marsupites testudinarius
Micraster coranguinum
Micraster cortestudinarium
Holaster planus

overlie the Middle and Lower Chalk.

Holaster planus near Little Massingham Church shows a continuous layer of flint and is exposed also west of Harpley Church.

Micraster cortestudinarium underlies Rudham, Tattersett and Syderstone and is exposed in the valley between Stanhoe and Burnham Westgate.

Micraster coranguinum occurs at Burnham Overy.

Marsupites has been found by R. M. Brydone at Holkham, East Barsham, and Uphall.

The *Actinocamax quadratus* zone occurs at Attlebridge, Whitwell and west of Holt.

From Fakenham eastward the Upper Chalk is reached by shallow quarrying, the greater number of pits being in the *Belemnitella mucronata* zone. Good exposures are seen in the Norwich area at Whitlingham, Catton, Drayton and Caistor; in the cliff sections at Weybourne, and in the huge erratics at East Runton and Overstrand. The curious "flower-pot" flints, the "paramoudras," have attracted attention and speculation as to their origin. At Thorpe Village and Whitlingham the highest portion of the *Belemnitella mucronata* zone is very fossiliferous, the large domed variety of *Echinocorys scutatus* (Leske), *Micraster* of *coranguinum* type and *Epiaster* are characteristic. Rather lower portions of the same zone are accessible at Hellesdon and Spixworth and *Rhynchonella limbata* (Schloth) variety *lentiformis*, *R. plicatus* (Sby), *Liothyrina carnea* (Sby), *Terebratulina striata* (Wahlen), *Crania costata* (G. B. Sby), *Cidaris subvesiculosa* (d'Orb) and *Lima decussata* (Goldf.) may be found.

The only British exposure of the *Ostrea lunata chalk* occurs at Trimingham, but at present the cliff section is inaccessible, being in the uncleared mine field. Good exposures may be seen at low tide on the foreshore. The chalk appears somewhat disturbed, probably by glacial action, but it occurs in the correct position, about sixty feet above the *B. mucronata* zone. The nomenclature has given rise to much discussion, Brydone objecting that *Ostrea lunata* does not occur throughout the zone, and recently, J. A. Jeletzky (Geological Magazine, May—June, 1951 p. 207) has suggested that *Belemnella lanceolata* should be accepted as the zonal name, pointing out that

Belemnitella mucronata does not occur and *Ostrea lunata* is found in certain bands only.

The chalk is easily soluble in rain water containing carbon dioxide, and solution hollows are formed, following lines of weakness, and along joints, often vertical. These hollows are locally termed, " pipes." The overlying later deposits may collapse into the pipe, particularly during periods of heavy rainfall, so that the chalk proves a treacherous foundation for buildings. Where the chalk level approaches the land surface, saucer-shaped hollows, often of considerable size, are thus formed. Near Sheringham, upstanding masses of naturally cemented rock, very resistant to erosion, have been explained by T. P. Burnaby (1950) as pre-Crag pipes.

The Tertiary Deposits.

Following the deposition of the Chalk, a period of mountain building ensued. The main structural effects of this were felt in southern England, and the floor of the Cretaceous Sea was broadly upheaved above present sea level and the chalk was subjected to tremendous erosion until a reversal of the movement brought the residual surface below sea level, and Eocene deposits—Reading Beds and London Clay—were thinly deposited on the south-east of the county. London Clay was penetrated below Yarmouth and in the well borings at Cantley and forms the bed below some of the broads. No deposits belonging to later Tertiary periods are known in Norfolk, but in early Pleistocene times the land to the south rose slightly and a westward-extending bay of the sea then occupying the North Sea basin moved northwards depositing the shelly sands, gravels and clays of the " Crags."

The Sub-Crag Stone Bed.

At the base of the Crag beds and, in Norfolk, usually resting directly on the surface of the chalk is a compact layer of flints, often cemented with iron oxide. It was evidently formed when the Crag Sea swept inland, washing away all floatable material and spreading the heavier and more durable substances over the flats or into the depressions. Among the flints are few other rocks, but many shells, often fragile but unbroken, and occasional bones and teeth, ivory and scarce wood. Among the flints are some which show cleanly flaked surfaces such as

characterise human workmanship. All the surfaces, flaked or not, are heavily patinated and deeply stained, and it is clear that the flaking was produced and exposed on the land surface preceding the arrival of the Crag Sea. The claims by Reid Moir and W. G. Clarke that these flaked flints are the artifacts of early man have been widely accepted. Among the mammalian remains found, mainly at Bramerton, Thorpe, Whitlingham, or in the coast sections are elephant, horse and deer.

The Norwich Crag seems to have been laid down under estuarine conditions, rather than in land locked bays as the Suffolk Red Crag had been.

A continuous, though perhaps slow, cooling of the ocean temperature seems indicated throughout Crag times, the proportion of " southern " shells decreasing, and of " northern " shells increasing as the deposits are traced northwards; so also the proportion of " living " shells increases and that of " not known living " decreases. However, there seems no sudden influx of " colder " varieties until the change to the Weybourne Crag with an abundance of *Tellina balthica*, perhaps indicating the opening of freer communication with northern seas. Of the Norwich Crag, about 89 per cent are living species including *Astarte borealis* (Chem), *Cardium edule* (Linn.), *Cyprina islandica* (Linn.), *Tellina obliqua* (J. Sby.), and *Littorina littorea*, and of these *Cyprina islandica* ranges as far south as the Bay of Biscay.

Resting on the Norwich Crag are patches of fine micaceous sands, overlain by micaceous clay, named after the exposures at Chillesford in Suffolk. Harmer considered them to show the course of a former estuary, a part of the delta of the ancient Rhine, the abundance of mica suggesting its southerly origin possibly from the Ardennes. A slight depression of land to the north appears to have ushered in the Weybourne Crag. These deposits are particularly well seen in the cliff sections from Weybourne to East Runton and beyond Cromer to Overstrand especially above the well known chalk erratics. Boswell (1952) has emphasised that " earth movements were in operation in Crag times and, since the deposits are of similar lithological character throughout must have proceeded *pari passu* with sedimentation. These conditions resulted in the accumulation of 170 feet of Norwich Crag in the Lowestoft

(Reproduced by courtesy of the Geologists' Association.) T. P. Burnaby

Tubular Chalk Stacks at Sheringham.

area and of 150 feet of comminuted crag of doubtful age in mid-Suffolk and Norfolk, the underlying chalk being folded along a S.W.—N.E. axis to produce a syncline more than 200 feet deep. . . . Although the East Anglian area is one which may well have been the scene of an interplay between isostatic and eustatic ice movements, according as the ice sheets in polar regions waxed and waned, a belief in the persistence of independent tectonic movements had already become necessary in order to explain the levels and character of the post-Icenian deposits." He adds, "There is no direct evidence that any of the Crag deposits was laid down during a glacial episode. The evidence for climatic deterioration is twofold—the faunal evidence given by the shells and the presence of far-travelled boulders some evidently from the north; but these erratics afford no better evidence of a glacial episode than do those dropped from melting icebergs at the present day in the North and South Atlantic Ocean."

The Cromer Forest Beds.

Resting in hollows of the Weybourne Crag, sometimes replacing it and lying directly on the Stone Bed are patches of estuarine and fresh-water deposits known as the Cromer Forest Beds, though the name is misleading, since the trees have obviously drifted and not grown in situ as a forest. The patches are scattered from Pakefield and Corton, and then occur more continuously from Bacton to Weybourne. They do not seem to extend far inland and appear to have been laid down by a great river curving from a direction of flow north to north-west and then again north, the deposits forming on the inner side of the bend. The full succession includes two freshwater beds separated by estuarine strata in which most of the wood occurs. The Lower Freshwater Bed consists of peaty clays and has been largely broken up by the formation of the Estuarine Beds in which are found the majority of the bones and teeth for which the series is famous. The Upper Freshwater Bed consists of peaty loams containing fresh-water snail and mussel shells as well as vegetable remains, bones and teeth. The extraordinary mixture of animal life has given rise to much discussion, and the fact that the majority of the specimens have been obtained after the sea has swept

them from the clay or gravel has raised the question whether the different specimens really belong to the same ages and the same deposits. The Pliocene elephant, *Elephas meridionalis*, survived together with its more specialised descendants, *E. antiquus* adapted to forest conditions ,and *E. trogontherii*, better suited to grass lands and steppe. Scarce teeth of the mammoth, *E. primigenius*, evolved from *E. trogontherii*, suggest tundra environment as do musk ox and glutton. Other characteristic animals are *Hippopotamus*, *Rhinoceros*—both *etruscus* and *megarhinus*, *Equus stenonis*, *Machairodus*, *Hyaena* and *Ursus*. The Upper Freshwater Bed, consisting of peaty loams containing freshwater shells and small bones of voles and shrews, lies in erosion hollows of the Estuarine beds. Harmer's graphic picture of the conditions at this time may be quoted (Harmer, 1902). "A bird's-eye view of Norfolk at this period would have been one of low sandy plains covered by woods of spruce or Scotch fir, with groves of beech, oak or elm in places, and a tangled undergrowth of bramble, hawthorn and hazel. On the west rolling chalk downs ; on the east broads and swamps, filled with aquatic plants such as now grow in the district and fringed with thickets of alder, willow and birch. Further to the east lay the great estuary, often swollen and turbid, and then sweeping down, with other flotsam and jetsam, the stools of trees, torn from its undermined banks, and, from time to time, the carcases of elephant or deer. Beyond the Rhine, on the opposite shore a vast plain now covered by the sea, but then dark with pine forests, stretched eastward to the distant horizon and thence to Holland. The plant and animal life of East Anglia at this period was varied and abundant. The Broads and streams, which, as at present swarmed with fish—pike, roach, perch and bream—were margined with the water lily and the water plantain, and with masses of dock, sedge and reed. The marshes were gay with meadow rue and cotton grass, and with buttercups and the golden flowers of the Caltha, while here and there arose a great clump of the royal Osmunda. Flocks of geese and wild duck, undisturbed by tourist or sportsman, made their home in these inland waters, and in the evening the owl, on noiseless wing, scoured the county in search of its prey. Squirrels scampered through the trees, and frogs croaked in the meadows, dotted

then, as they are to-day, by the rounded hillocks of the mole. From their holes in the river banks or their lairs in the reed beds, otters issued for their nightly fishing, while beavers were busy in the construction of their dams. Smaller animals, as mice, shrews and water voles everywhere abounded and the poisonous adder lurked in the woods."

The wealth of the Forest Bed fauna and the involved mixture of animals associated with warm conditions on the one hand and with even sub-arctic climate on the other, have given rise to much discussion and to suggestions that the separate exposures may be of very different ages. The question is obviously of outstanding importance with regard to the Continental deposits. The appearance of *Elephas meridionalis* and *Equus robustus* suggests correlation with the Günz-Mindel interglacial. However, Hopwood (1940) has sounded a warning against too facile correlation. "The Pleistocene succession has been studied in many countries, and in each instance it has been shown to consist of an alternation of so-called 'warm' and 'cold' deposits. Moreover, the 'cold' deposits have been proved to fall into four main groups. This on the face of it, is an invitation to label the groups in each country according to the Alpine standard, but the grouping in England is more obscure than in many other places, and at times there is no general agreement whether two boulder clays represent two different glaciations or whether they are different facies of one and the same glaciation. . . ." "Gradual changes (of fauna) took place throughout the Pleistocene. After the first interglacial 'old-fashioned' species such as *Hyaena avernensis, Canis nescherensis, Equus robustus, Equus stenonis, Rhinoceros etruscus* and *Elephas meridionalis* became extinct, and new forms such as *Bos primigenius, Rangifer tarandus* (very rare), *Rhinoceros tichorinus* (rare), *Ursus spelaeus* (rare), and *Hyaena spelaea* (not common) appear for the first time during the second interglacial and lived contemporaneously with 'warm' species such as lion and *Elephas antiquus*. There is less difference between the faunas of the second and third interglacials, but *Elephas antiquus, Rhinoceros megarhinus* and the cave lion all became extinct at the end of the third interglacial. During the fourth glacial the following species all became extinct: *Elephas primigenius, Rhinoceros tichorinus, Hyaena spelaea, Ursus spelaeus.*"

Kennard (1942) has stated, "The so-called Forest Bed has been the cause of much trouble, largely because it is really an aggregate of beds of various ages. The deposit at West Runton is older than any superficial deposit in the Thames Valley, though it shows affinities with the High Terrace. The beds at Bacton are probably the same age as those at Grays, whilst the Arctic Freshwater Bed is the equivalent of the Ponders End." Oakley (1942) considers that "At West Runton the North Sea Drift overlies a part of the Cromer Forest Bed which yielded a fauna identifiable as equivalent to that of the Mauer Sands of Günz-Mindel Age."

A glance at the list of Cromer Forest Bed fauna, which includes southern elephant and mammoth, machairodus and musk ox, suggests that revision and re-identification are very necessary; whilst elk, red deer, and elephant in varying states of mineralisation in situ in the shallow sections at East Runton certainly call for investigation.

The coastal sections are constantly changing as the cliffs recede, and it is seldom possible to obtain direct evidence connecting one patch of the deposits with another, especially as talus from the cliff falls hides long stretches of the lower cliff slopes. So also in places contact is interrupted when the glacial clays cut down through Forest Beds and Crag to the underlying chalk. Little of the Forest Beds can be seen at Happisburgh, but there appear to be considerable thickness below sea level and quantities of bones were recovered when oysters were dredged many years ago. At Bacton the deposits lie mainly below beach level and are usually sand covered, best accessible when a north-westerly gale sweeps the beach. This area has in the past been very productive of elephant teeth and tusks, whilst recently the skull of a great bear and a jaw of *Hyaena* have been recovered. The deposits show at the cliff base between Bacton and Mundesley and have produced rhinoceros, hippopotamus and glutton. From Mundesley to Overstrand the beds are fairly continuous though much hidden by talus, whilst the still inaccessible minefield at Trimingham prevents investigation of the promising sections there. At Sidestrand, the Unio bed is very fossiliferous, but mammalian remains are scarce. At Overstrand the excessive erosion has provided continuously fresh sections for many years. The

groynes have held up erosion between Overstrand and Cromer and the only exposures usually workable are between tide marks. The Old Lighthouse Cliffs (Reid, 1882, 28) produced "several hundreds of elephant teeth and yet probably the locality is not exceptionally fossiliferous," but few finds await the searcher now. From Cromer to East Runton little erosion occurs and the beds are usually hidden by sand. At East Runton thin estuarine deposits are usually accessible and at West Runton the Upper Freshwater Bed is well exposed by the tiny stream east of the Gap, and recent finds include a horse hoof—a rarity. Further westward to Sheringham and Weybourne the estuarine gravels appear above the Crag but are not easily distinguished from the closely similar marine deposits except where fossiliferous. West of Weybourne they are not recorded.

The Glacial Deposits.

Solomon's recognition of the deposits of four distinct ice sheets in the spectacular cliff sections forms a convenient scheme for the description of the beds, though his use of the microscopic analysis of the heavy mineral residues has been criticised as inadequate to distinguish definitely between the deposits of different ice advances. Thus Bull (1942) objects that "it is obvious that if two successive ice sheets came over the same ground they would gather up identical mineral assemblages, and therefore if two boulder clays show the same mineral content this should not by itself be taken as sufficient evidence of identity," though Solomon had emphasised that his basis was field observation, microscopic analysis being treated as confirmatory only. Later, Solomon included in the North Sea Drift series the underlying Leda Myalis and Arctic Freshwater Beds. In a recent communication to me he says, "My ultimate conclusion was that the Cromer Till and Norwich Brick-earth were simply a glacial facies in the middle of a big thickness of glacio—marine sandy deposits which include the Leda Myalis, Bure Valley Beds and 'mid-glacial sands.' It is especially important to note that the latter, with the exception of a few genuine outwash deposits around river valleys, have nothing to do with the overlying Chalky Boulder Clay. Their lithological content both microscopic and macroscopic shows

this quite plainly." However, Boswell has " never accepted as definitely established the grouping of the Cromer Till with the Norwich Brick-earth. The Till is so much more fresh looking, is nowhere proved to be weathered and subaerially eroded before being covered, and has that mixed assemblage of erratics including Jurassic material, so that I would rather refer it to a later stage. Mineral assemblages should be used with great caution ; by themselves they may indicate a different source but not necessarily a different age." (Recent personal communication.)

Paterson's short summary of the " Pleistocene Stratigraphy of the Breckland " (Nature, May 13th, 1939) traces the sequence in a little studied part of the county, and distinguishes three boulder clays.

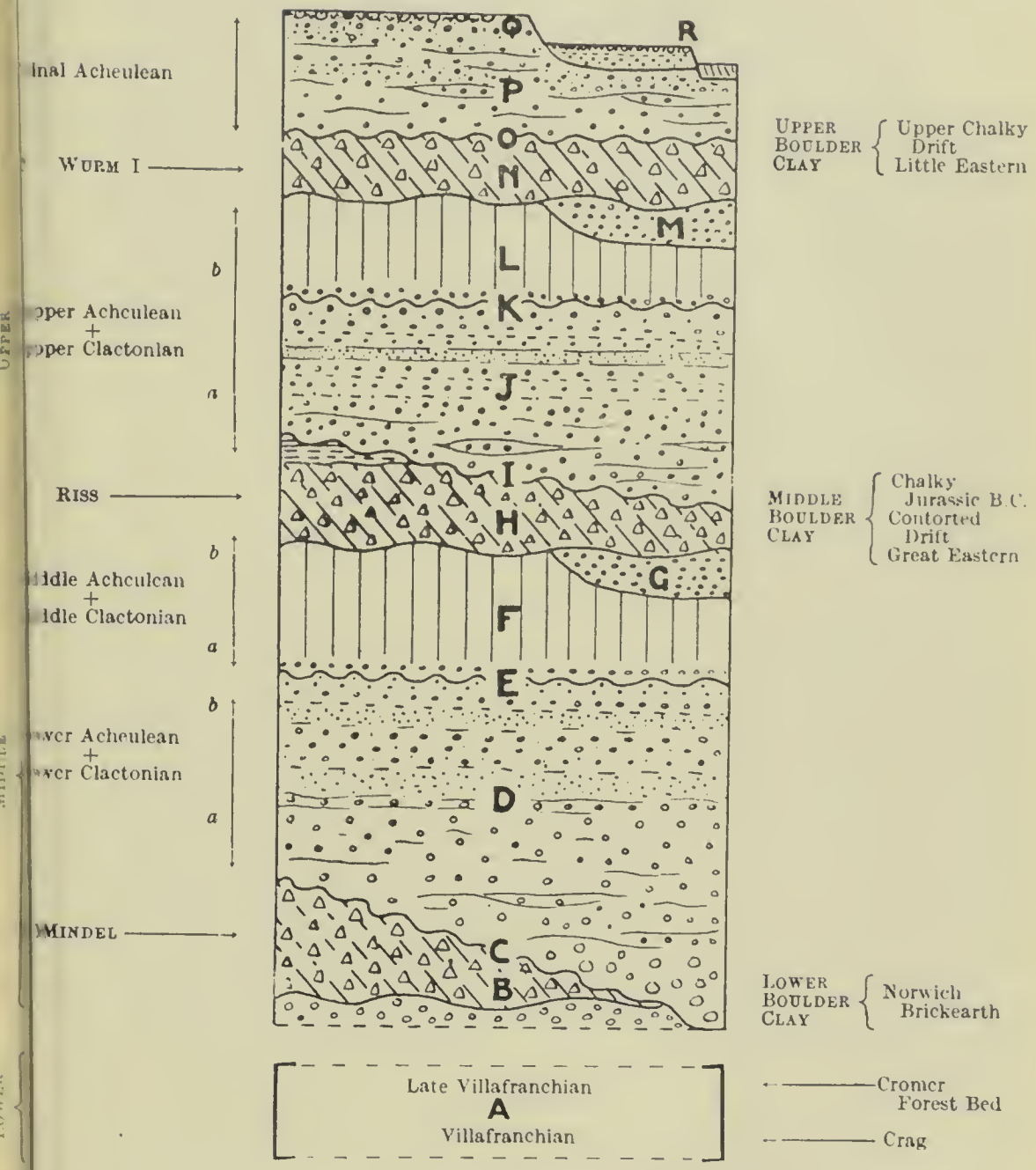
His description starts with the lowest of the beds, the Lower Boulder Clay (B) which contains erratics from Scotland, Yorkshire and Scandinavia as well as Jurassic (mainly Kimmeridgic) material. It is found only on the slopes of shallow ancient valley forms and on higher ground, having been removed principally by a long period of erosion (C) which succeeded the ice advance and was related to a period of uplift. This must have been quite extensive since valleys several hundred feet deep were then cut out, and it is the period when the major features of the present landscape were decided.

A great period of aggradation filled these valleys with gravels (D) up to about the level of our present river system. A period of increased rain deposition led to some slight erosion (E) and subsequent formation of a loam (F).

Another period of slight aggradation (G) was followed by advance of an English glacier (H) when the land was depressed some 150 feet and the Middle Boulder Clay was deposited.

The sequence of the first interglacial was repeated but during a shorter second interglacial ; uplift was followed by erosion (I), valleys being excavated, generally along previously established drainage lines. Aggradation (J) was followed by a colder oscillation (K) and the deposition of loam (L) in temperate conditions.

Slight erosion (M) cut into the loam, and the Upper Boulder Clay (N) was deposited as a skin over the greater part of Breckland. The Middle and Upper Boulder Clays are very much



From T. T. Paterson (1939) by courtesy of "Nature."

alike, carrying a great quantity of English, especially Triassic, erratics and none from very far parts. Moreover, they are coloured brownish by reason of loam and clay derived from an earlier interglacial deposit.

An erosion phase (O) cut into the Upper Boulder Clay forming the present radial drainage of the area.

A middle terrace (P) was formed of well bedded gravels, succeeded by a bed (Q) showing sludging under severe cold.

A late Low Terrace (R) was formed by a period of erosion and aggradation.

The sequence in the Lowestoft—Waveney Valley region has been classed by Baden-Powell as follows :—

Peat
Estuarine and Marine Deposits } The Broads

Erosion of Lopham Ford Gap

Glacial Outwash Gravels [=Upper Chalky Boulder Clay]

Hoxne Interglacial Series

Erosion

Lowestoft Boulder Clay [=Lower Chalky Boulder Clay]

Erosion

Corton Beds—Marine

Cromer Till

Pebbly Series

Cromer Forest Bed or Chillesford Clay

Since the cliffs of the North Norfolk Coast present such a long series of accessible sections, the detailed description of the deposits may be dealt with mainly in the order in which they occur there.

The Leda Myalis and Arctic Freshwater Beds.

The Leda myalis bed is a marine deposit containing shells similar to those of the Weybourne Crag, together with scarce specimens of the bivalved shell now called *Yoldia myalis*. Clement Reid placed the Arctic Freshwater Bed above this, but Solomon disagrees. No exposures of the Arctic Freshwater Bed have been seen recently, but in 1872 Nathorst of the Geological Survey of Sweden, discovered immediately under the Till at Mundesley a bed of clay and loam containing *Hypnum turgescens* and leaves of *Salix polaris* (see Reid, 1882,

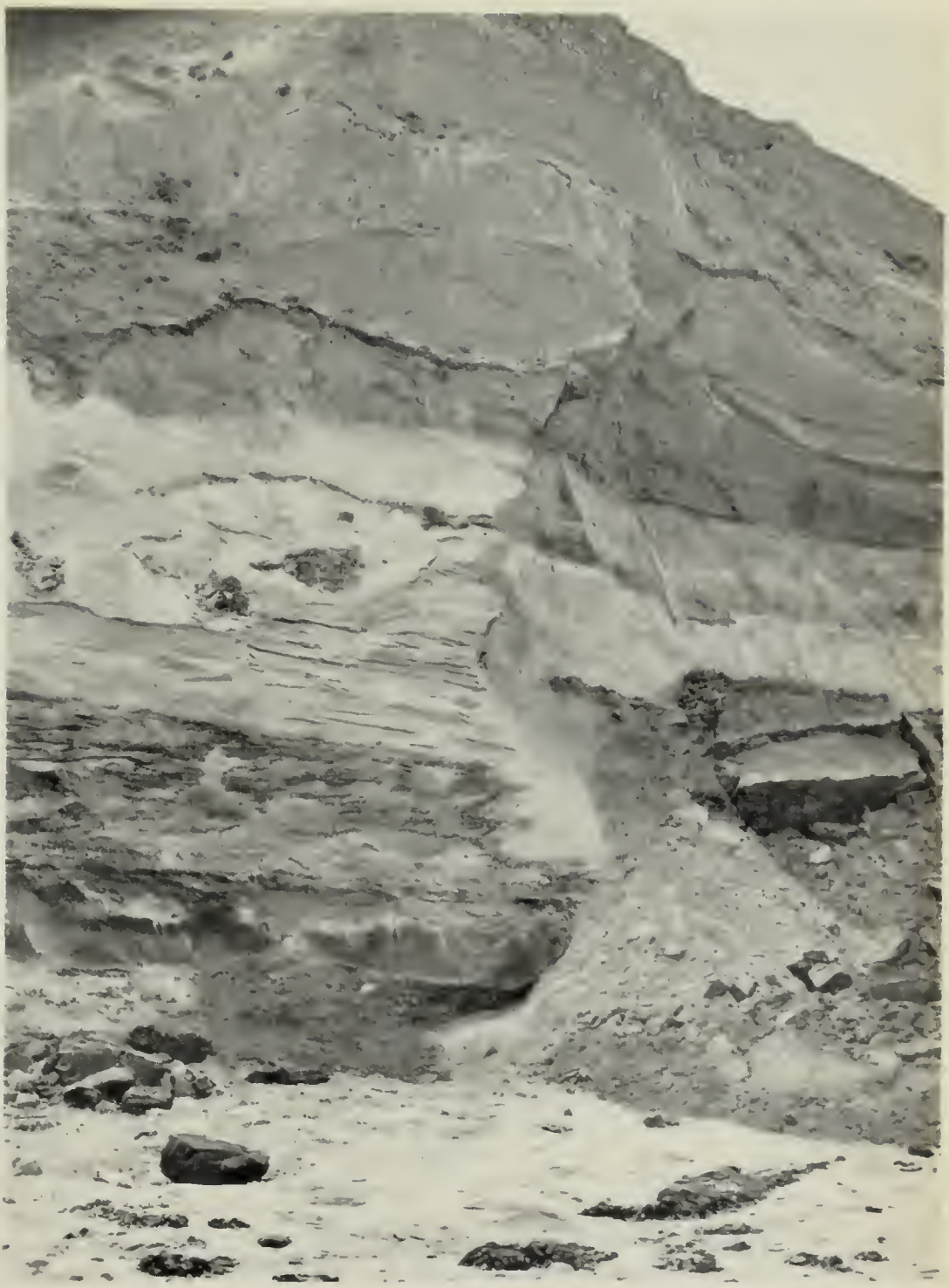


Photo : Hallam Ashley

Cliff at West Runton, showing Cromer Till overlying Leda myalis Sands and Upper Freshwater Bed.

83). The *Leda myalis* sand is best examined on either flank of West Runton Gap. At Bacton the proportion of North Sea Drift minerals in it increases, and further east the bed appears to be replaced by the Till.

The Bure Valley Beds occupy inland a position corresponding to that of the *Leda Myalis*, lying between the Norwich Crag and the Norwich Brick-earth, but Scandinavian minerals do not appear around Aylsham. Similar beds lie over the Norwich Crag at Thorpe Village Pit and below Norwich Brick-earth at Sprowston.

The Tills and Norwich Brick-earth—The North Sea Drift.

The Lower Till is a tough sandy boulder clay always grey and except for pebbles, homogeneous in texture and lacking stratification and irregularities such as sand galls. The underlying beds are not disturbed except where both deposits have suffered subsequent contortion, suggesting that the boulder clay was formed by the melting out of ice in water. This Grey Till contains much chalk and flint, often green coated, quartz and quartzite, schist and gneiss; some igneous rocks, both Scottish and Scandinavian; marcasite nodules, lignite, peat and occasional Jurassic material. The heavy mineral assemblage suggests that the ice reached this area from a direction somewhat east of north.

The Mundesley Sands are uniformly fine textured and very dirty, finely false bedded, chalky and carbonaceous, this imparting a distinctive greyish tint. They attain a thickness of 45 feet near Mundesley and play a considerable part in the structure of Beeston and Skelding Hills.

The Upper Till can be distinguished from the Lower Till only when the intervening sands are developed, elsewhere it probably overlies it directly. It is a sandy clay, bluish-grey near the base, but usually brownish near the top, the change corresponding to a change in mineral composition due to the incoming of new material. It contains fewer stones and less chalk than the Lower Till. In places the Tills contain material derived from the Cromer Forest Beds; peaty matter, wood, distinctly stained flints, bones and teeth have been found. One specimen from the Till at Sidestrand (Moir, 1923) has

been described by Dr. Zeuner (1946, 186) as "a beautiful Abbevillian hand axe," and its importance stressed as indicating the presence of man in Forest Bed times.

Two great erratics of chalk—one, the well known specimen just west of East Runton Gap, extending for some six hundred yards and reaching in places to the cliff top, and the other, now showing on the east of Overstrand and looming larger as the cliff erodes, is already four hundred yards long—have obviously been derived from the chalk of the sea bed, probably not at any great distance.

The Norwich Brick-earth is distributed over east Norfolk and reaches as far south as Beccles. It is a yellowish brown or greyish sandy loam and includes Scandinavian erratics, though chalk and flint are most numerous. The manner of their occurrence and the composition of the Brick-earth suggest the possibility that the deposit was produced by the transport action and subsequent melting of icebergs rather than land ice. It is exposed in sections at Sprowston and Blickling.

The Mid-Glacial Sands and Gravels are now considered by Solomon as part of the Westleton Beds in which the Norwich Brick-earth occurs as lenses. They indicate the recession of the North Sea Ice and give rise to "well wooded estates, rhododendron avenues and beautiful open heaths" (Boswell, 1935, 55)

The Corton Sands are well exposed in a series of basin shaped hollows in the Till between West Runton and Beeston. The mode of deposition suggests a succession of beach deposits piled up to a height of at least eighty feet above present sea level. The assemblage of shells does not entirely agree with any known Crag horizon, since among those typical of the Weybourne Crag are later comers, *Chlamys varia* and *Astarte elliptica*. Inland the deposit can be recognised by the completeness with which the gravel grade has been separated out from the sand grade into false bedded banks and partly by the abundance of drifted wood and peat (Baden-Powell, 1938a, 212.) Towards the west the Corton sands are capped by thin deposits of chalky boulder clay as they are also in a now derelict pit south of the Cromer Road at East Runton. They have been intensively studied by Baden-Powell and Reid Moir, who have found a coarse flake industry in the sands.

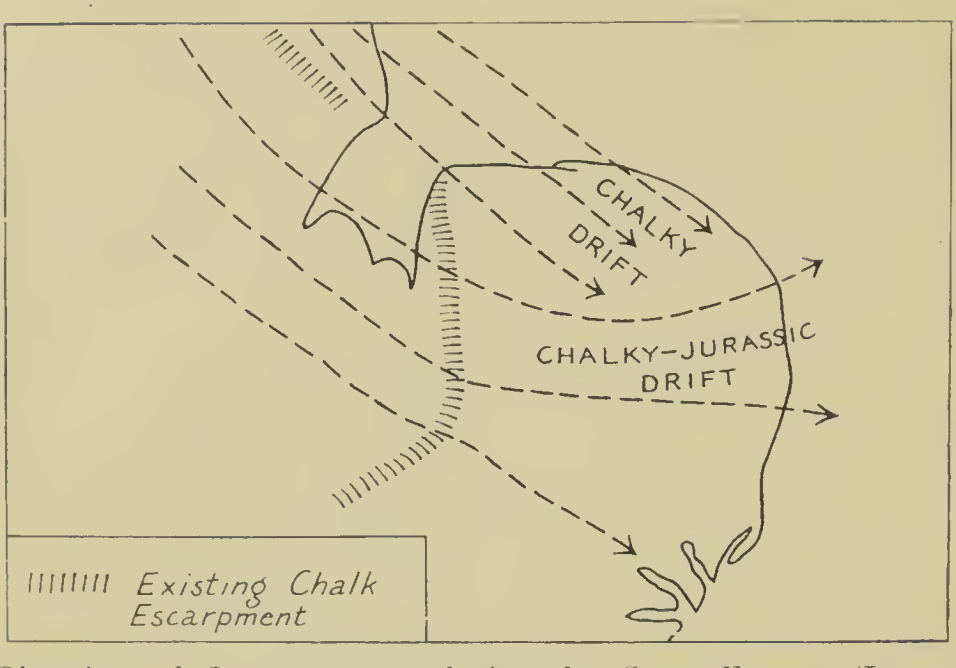
The Interglacial period intervening between the North Sea Drift and the Great Chalky Boulder Clay (Solomon's Great Eastern) produced intense erosion, the river valleys of central Norfolk being cut down through North Sea Drift, whilst the Chalky Boulder Clay flows down into the valleys thus eroded. Faunal remains are scanty and the evidence from the flaked flints is not decisive.

The Chalky Boulder Clays.

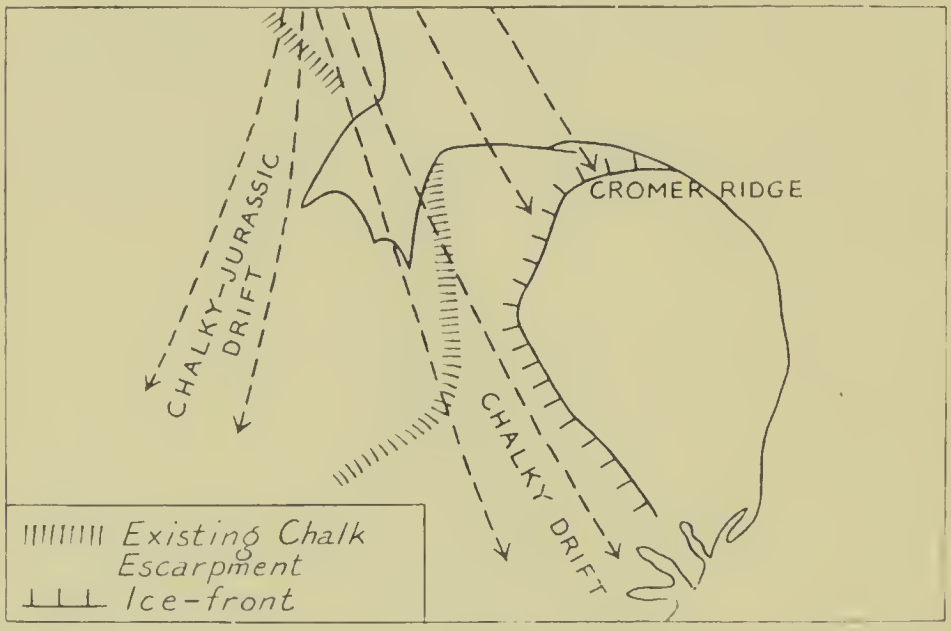
With the exception of the Hunstanton Purple, all the boulder clays of Norfolk are essentially "chalky," and the problem of differentiating between them has proved difficult. An ice sheet moving south-eastwards over the Lincoln Wolds would bring into North Norfolk chalk and flint from the outcrop, but the more westerly portion of the same ice sheet would pick up Jurassic and Neocomian material as it crossed the Fenland area. Fieldwork has shown "that the chalky boulder clays are mainly divided into two types: a dark type consisting essentially of chalk and other pebbles in a matrix of sand and Jurassic clay, and a pale type which consists of pebbles of chalk, flint and other rocks in a sandy chalky matrix." (Baden-Powell 1938b, 283). The two kinds are seldom seen in direct superposition, but various workers have suggested that there are probably two deposits of each, the product of two distinct ice sheets, and that they are associated with fluvio-glacial gravels of "cannon shot" type.

The Great Eastern Chalky Boulder Clay (Paterson's Middle Boulder Clay).

The ice sheet producing this deposit appears to have travelled from the north-west, and in the greater part of north and central Norfolk the heavier clay lands are of the chalky variety, but in the more southerly regions the Jurassic type is prevalent. The junction of the two types can be seen at Bawsey, east of King's Lynn, and on the coast near Scratby, north of Yarmouth. Violent contortions are typical of the zone of contact. The deposit appears to have been mostly the product of land ice. Dr. Slater has traced from Happisburgh to Weybourne a succession of built-up mounds of chalk, marine deposits and till, of drumlin-like form, separated by basins of deposition containing mainly sandy deposits.



Direction of Ice-movement during the Great Eastern (Lower Chalky) Glaciation.



Direction of Ice-movement during the Little Eastern (Upper Chalky) Glaciation.

(After Baden-Powell, 1948.)

By courtesy of Geological Magazine.

The *Jurassic type* is typically developed around Lowestoft, especially in the coast section at Corton, where it rests on the marine Corton Sands. At Somerleyton it lies above Till and it can be seen in sections in the Waveney Valley. The matrix consists of a mixture of Jurassic clays and sands, and is either dark blue or dark brown according to its degree of weathering. The commonest erratics are hard chalk and flint, Jurassic material, Neocomian sandstone, Bunter quartzites and quartz, basalt and dark blue limestone. They suggest ice movement from the Southern Pennines. Small bits of red chalk occur sparsely.

The *chalky type* is paler and its matrix is of chalk and sand; it is not easily distinguished from the later Little Eastern Chalky Boulder Clay, as the mass of chalk and flint masks the scarcer erratics. The Chalky Boulder Clay of North Norfolk may be seen at East Runton, Weybourne and Cawston, as well as in the small exposures in the cliff at Beeston.

The Ridge Gravel.

The Cromer Ridge, running from Holt to the coast at Mundesley, shows in its interior an important gravel formation. It is well bedded but poorly sorted, the boulders being scattered through layers of sand and finer gravels False bedding is seldom seen and no fossils have been found except a single fragment of badly decayed bone at Briton's Lane Pit, Beeston. Erratics are common, igneous and metamorphic rocks being frequent, probably of Cheviot types. The bedding is fairly horizontal and cut off by the hill slopes, but folding is shown at North Repps and in a pit near the "Roman Camp" at West Runton. The large quarry at Briton's Lane shows specially clearly the "unsorted, well-bedded" nature. The flints are not all well rounded and vary much in colour. The age of the deposit is uncertain but it appears later than the Corton Sands and may be associated with the Great Chalky Boulder Clay glaciation. A great part of the height (over 300 feet) of the Ridge is due to the great thickness of the Ridge Gravel.

The Bacton Valley Gravel fills a shallow valley with its base about 15 feet O.D. and has yielded a molar of *Elephas primigenius*, but lacks the pale grey flint typical of Little

Eastern gravels. It may represent a formation of the interglacial period separating the ice sheets of the Great and Little Eastern glaciations. At Hoxne in Suffolk a large number of Acheulean hand axes have been obtained from deposits above the Great Eastern Chalky Jurassic boulder clay. The paleolithic gravels at Whitlingham and at Carrow have produced a series of similar hand axes, and at the latter site tusk and tooth of mammoth were recorded. Both Norfolk sites occur in stratified river terrace gravels about 40 feet above the present level of the Yare. These gravels appear to belong to the Hoxne interglacial and may thus be of the same age as the Bacton Valley gravels. The succeeding Little Eastern deposits have produced a similar paleolithic industry in many areas of the county, and this confirms the view that the interval between the Great and Little Eastern ice advances was the period of the " mammoth hunters " and makers of Acheulean implements. The thin deposits of gravel capping the cliff at West Runton were classified by Clement Reid as " Valley Gravels " because of the presence of paleolithic implements, and may well be of the same interglacial age as the Bacton and Whitlingham series.

The Little Eastern Chalky Boulder Clay, the Upper Chalky Boulder Clay of T. T. Paterson.

This appears to have been formed by ice moving from a more northerly centre than that of the Great Eastern Glacier. On entering Norfolk (Baden-Powell, 1938b, 286) it moved along the strike of the chalk, producing the intensely chalky boulder clay of the Ipswich area. The matrix is a mixture of chalk and sand with some pale brown clay and the erratics consist of flint, hard and soft chalk, Red Chalk (common), Bunter sandstones and quartzites, porphyrites of Old Red Sandstone types, and felspathic grits. Some of the flint has typical blue-and-white " basket work " patina, which seems to be lacking in the Great Eastern Boulder Clay. It weathers into an unbedded, unsorted boulder gravel of which the matrix is usually highly ferruginous. It can be examined around Thetford, West Harling Heath, Garboldisham Heath and Quidenham brickworks, but not apparently in South Norfolk east of Quidenham. At Southacre it is closely associated with gravel containing paleolithic hand axes. To the east it is replaced by cannon-shot-like gravels, which are sometimes sufficiently

bedded to be outwash gravels from this ice front. The weathered clay is dirty white, but a clean fresh section appears yellowish to khaki, sometimes, as at West Harling, being brown coloured from incorporated brick-earth. In North Norfolk the small exposures of chalky boulder clay at Beeston and in pits at East Runton, Weybourne, and Cawston may be of the earlier age, but the cliff top gravels at West and East Runton, Overstrand and further south-east have produced hand axes of Acheulean types such as are found in gravels of Little Eastern age at Southacre and Syderstone, Great Bircham, Ketteringham, Great Melton, Massingham and the Breckland.

Solomon (1933, 177) states that " the Little Eastern gravels rarely show any sorting or stratification ; they invariably contain a large proportion of angular gray flint, sometimes stained brown. Over most of the Breckland they are notable for their great content of pebbles of Bunter quartzite ; further to the north and east this is replaced by ferruginous sandy concretions derived from the Lower Greensand around Sandringham ; whilst north and north-east of Fakenham their content of angular gray Lincolnshire flint is ample to afford distinction from the Great Eastern gravel with its predominant rounded pebbles of dark flint."

Of the " Later Ridge Gravel," Baden-Powell (1938, 215) writes, " Occurring as a veneer on the top and sides of the Cromer Ridge is a gravel having its bedding with the slope of the hill, unsorted and uneven. Rounded battered flints which are grey inside make up ninety per cent of its content and there is little variation of patina. Some flints show the basket work patina. Foreign erratics are extremely rare in a pit in this deposit. The scarcity of igneous and metamorphic erratics in the gravel may be a local phenomenon, but it is a striking enough character to help in distinguishing the two gravels in the field, especially between Sheringham and Blakeney. It can be easily examined in the pit at the north end of the Blakeney esker by the coast road to Morston.

In a recent paper Farrington and Mitchell (1951, 105) point out that " The Cromer Ridge over the greater part of its extent is mature, showing smooth and even slopes, and it is only at the northern edge that the topography is rough and uneven. Here, study of the surface indicates that the roughness is due to

erosion and not to deposition. The north slope is trenched by deep valleys; here and there spurs run northwards towards the coast; sometimes mounds of gravel (as at Muckleburgh Hill) stand isolated from the main mass—nowhere is the 'tossed' topography of a young frontal moraine seen. Valley furrowed slopes ('false hills') are recognised as special erosion forms in Denmark."

The Morston Raised Beach. Between Morston and Stiffkey, Solomon discovered an old shingle beach running from east to west along the edge of the marshes; it contains much pale grey flint derived from the neighbouring mounds of Ridge Gravel and appears younger than the Cromer Ridge. Its base is about 15 feet above present sea level. It is directly overlain by Hunstanton Boulder Clay. It obviously represents a marine incursion and may be directly related to the Nar Valley Beds in West Norfolk, deposited by a sea which formed beds of gravel at March, containing shells indicating a climate rather colder than that of to-day.

The Nar Valley Clays.

Baden Powell considers that the marine fossiliferous gravels at Hunstanton were formed by the same submergence as the March gravels and Nar Clays. He estimates the general average of relative higher sea level as about 40 feet. With shells indicating a somewhat colder climate than the present are recent marine shells. They have recently yielded a fine tooth of mammoth.

The Hunstanton Boulder Clay.

The latest of the Norfolk boulder clays is found west of Morston, overlying the ancient shingle beach, the pebbles of which are incorporated in the lower part of the clay, and fringing the marshes. The ice sheet does not seem to have surmounted the Cromer Ridge in strength, though A. Q. Watson and I found the clay in situ in a section in the road cutting south of Stiffkey at a height of 60 feet, O.D. Inland deposits of reddish-brown boulder clay present superficial resemblance to the Hunstanton clay, but in most cases may be distinguished from it by the erratics. The Hunstanton clay contains a different suite of erratics from either the Little Eastern of the Ipswich area or from the Upper Boulder Clay of the Brecks. Chalk is

Hessle Boulder Clay over Raised Beach at Morston.

Photos: Hallam Ashley

Detail of Upper Freshwater Bed at West Runton.

practically absent, the dominant specimens being dolerites, dark blue greywacke grits, and porphyrites of Cheviot type—an assemblage characteristic of the Hessle Clay of Yorkshire and Lincolnshire. The most extensive exposure available is in the brickfield in Holkham Park ; the gas-works sections at Hunstanton are hidden and the thin exposures further west are possibly disturbed. A few worked flakes and cores for which an Upper Paleolithic date has been claimed have been found in situ, but more evidence is desirable. At Morston the thinly weathered upper layer contains an industry of " Mullerup " type suggesting that this was the surface first colonised by the Mesolithic hunters and emphasising the absence of any later glacial deposits such as have been recognised north of Flamborough. The cold episodes giving rise to such deposits may be represented here by solifluxion effects but are not easily to be distinguished from those of the earlier ice sheets.

Farrington and Mitchell (1951, 105) consider that " The exposures of Brown Boulder Clay at Holkham and at Hunstanton lie in a terrain of low relief and that the sections show a boulder clay which has been weathered to a considerable depth. The same features can be seen at Hessle, and neither in Norfolk nor south Yorkshire does the relatively subdued topography or the weathered state of the drift suggest any affinity with the fresh features " of the drifts of the final ice advance.

The scenery of the northern slopes of the Cromer—Holt Ridge, with the rounded hills *en echelon*, separated by abrupt wooded ravines is unequalled elsewhere in East Anglia. It undoubtedly results from glacial action, the building up of the masses to a height of over 300 feet, O.D being apparently due to the earlier ice sheets, perhaps mainly to the Great Eastern, but the dissection of the plateau and the detailed erosion must have been accomplished by the Little Eastern and Hunstanton advances. At Blakeney and in Hunstanton Park are eskers—long gravel mounds formed by englacial streams.

The later geology deals with the changes in the relative levels of land and sea, the formation of the Fenland silts and peat, the growth and submergence of the " buried forests," best studied at Thornham ; the formation of the Broads by a marine incursion that deposited the clay in the main drainage channel ;

the blown sand and drifted shingle of Blakeney and Scolt Head, and the dunes of Palling, Eccles and Waxham. The shifting sands of the Breckland were formed, not as formerly supposed by the extension of the sea beyond Fenland, but by the decalcification of the boulder clays.

The Correlation of the Norfolk and Continental Ice Sheets.

The problems of correlation have proved complex and difficult and no general agreement has yet been secured. The recognition in the Alpine regions of at least four separate glacial periods, named after the side valleys in which their deposits could be studied—Günz, Mindel, Riss, and Würm—and of the three interglacial periods of milder climatic conditions which intervened was followed by the realisation of corresponding changes in the relative levels of land and sea. The storing up in the ice fields of water evaporated from the ocean produced a lowering of the sea level by over 200 feet, laying bare great areas of former sea bed and adding an equivalent 200 feet to the relative height of the land. Conversely, the melting of the ice restored the former ocean level and inundated regions of adjoining land. These effects can be checked by the presence of raised beaches and submerged land surfaces. However, the simplicity of these eustatic effects was masked by isostatic movements when the northern lands, freed from the vast weight of the ice sheets, were elevated even beyond their former levels and the southern regions were correspondingly tilted down. The recognition that tectonic movements had continued into Pleistocene times introduced fresh complications ; whilst more intensive study of continental evidence regarding, not only the advances of the ice sheets and the interglacial and interstadial ice recessions, but also the faunal sequence and the evidence provided by the human industries, showed that the problems were more complex than had been recognised. The absence of confirmatory evidence for the Günz glaciation in Northern and Eastern Europe and the uncertainties in Switzerland and France have to be considered in connection with the Crag deposits. It seems possible that the Austrian Günz may have been associated with a cold episode producing local glaciers, and floating icebergs so far as the North Sea region is concerned.

Theoretical investigation of the causes of an ice age have resulted in the suggestion that these must be sought in variations in the intensity of solar radiation received by the earth, and the deduction has been made that each ice episode is necessarily two-fold. An increase in the intensity of solar radiation received would necessarily cause an increase of evaporation with heavier winter snow fall and more intense summer cloud, which would hinder the melting of the snow fields. Thus, ice sheets would gather until the temperature increase dispersed the cloud canopy and the glaciers would melt back. As the intensity of radiation decreased towards " normal " conditions, a second ice advance would occur and continue until the slowing down of evaporation cut off the snow supply. If these views are accepted we have for each ice age an advance and recession of the first ice sheet, a possibly brief warm " interstadial " period, and advance and recession of the second ice sheet. A more prolonged " interglacial " period would intervene between the separate ice ages. Also in each ice advance the locking up of oceanic water in the ice sheets would produce a lowering of sea level calculated as over two hundred feet and England would become continental. The melting of the ice sheets would restore the sea levels and the country again become insular. Accordingly, if the Cromer Forest Beds are, as is at present considered possible, of Günz-Mindel age, we should expect to find in our Norfolk deposits signs of six ice advances with three interstadial intervals and two pronounced interglacial periods. The task is obviously not easy, for each successive ice sheet might disturb or destroy the traces of its predecessor, incorporating the older erratics with its own.

The sequence of the Norfolk deposits recognised is as follows, the marine beds indicating the relatively high sea levels :—

Post-Glacial Deposits
Hunstanton Boulder Clay
Morston Raised Beach and Nar Valley Clay—marine
Little Eastern Chalky Boulder Clay and Gravels
Bacton Valley—Whitlingham—Hoxne Gravels—? interglacial beds
Great Eastern Chalky Boulder Clay and Sands
Corton (=Runton) Sands—marine

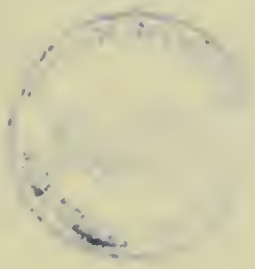
Second Cromer Till
Mundesley Sands—marine
First Cromer Till—Norwich Brick-earth
Leda Myalis and Bure Valley Beds—marine

Upper Freshwater
Estuarine
Lower Freshwater
} Cromer Forest Beds

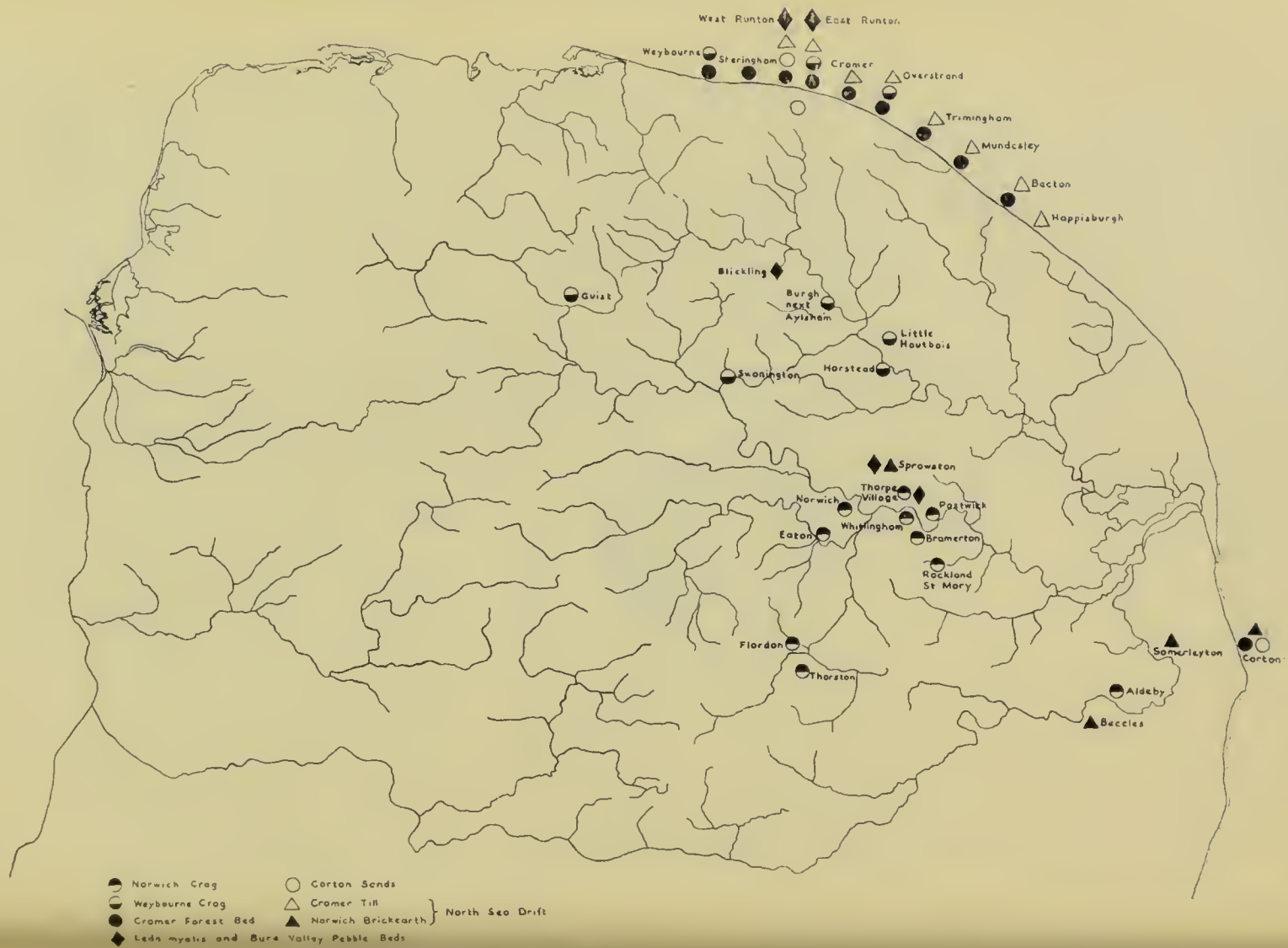
Weybourne
Chillesford Clay
Norwich
Red
} Crag—marine

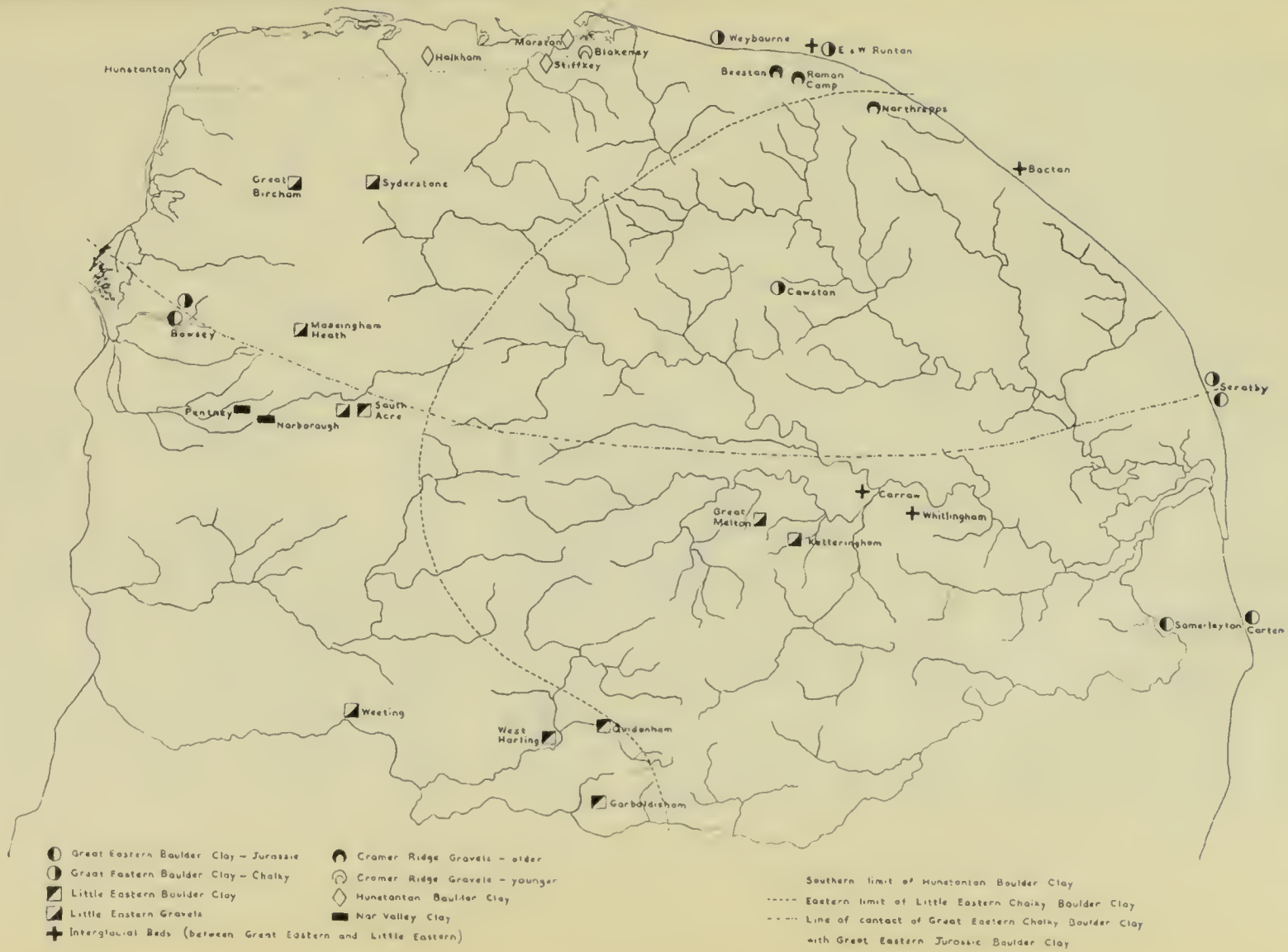
The Hunstanton Boulder Clay may be equated with one of the ice advances of the last ice age. The Chalky Boulder Clay at Southacre and the gravels at Syderstone and Runton of Little Eastern Age contain Acheulian implements similar to those of Whitlingham and Hoxne and may perhaps represent the first ice of the latest period. At the other end, the North Sea Drift =Cromer Till/Norwich Brickearth is usually considered of an age equivalent to the Mindel glaciation, but the intermediate deposits are difficult to date on the present evidence. The clarification of the problems of the Forest Beds and the Lower Glacial and mid-Glacial deposits is in the hands of the coming generation.

In conclusion, I must express my grateful thanks to those field workers—J. D. Solomon, D. Baden-Powell and T. T. Paterson, who so freely allowed me to utilise their results, and with whom the long discussions on the deposits have proved so stimulating and so valuable. To Professor Boswell this account owes whatever merits it may possess ; not only has he inspired the work but he has twice read the manuscript and clarified the ideas in it. I must also thank H. Apling for typing the notes and generally tidying up the account and C. D. Ovey for his assistance. The Editor, E. A. Ellis, must accept the responsibility for urging me to attempt this, but the final opinions and all errors are my own.



Distribution of Early Pleistocene Deposits in Norfolk.




Hunstanton
Holkham
Morston
Blakeney
Stiffkey
Weybourne
E & W Runton
Beeston
Roman Camp
Northrepps
Bacton
Great Bircham
Syderstone
Cawston
Bawsey
Massingham Heath
Pentney
Narborough
South Acre
Sea Palling
Carrow
Whitlingham
Great Melton
Wetteringham
Somerleyton
Carton
Weeting
West Harling
Garboldisham
Great Eastern Boulder Clay – Jurassic
Great Eastern Boulder Clay – Chalky
Little Eastern Boulder Clay
Little Eastern Gravels
Interglacial Beds (between Great Eastern and Little Eastern)
Cromer Ridge Gravels – older
Cromer Ridge Gravels – younger
Hunstanton Boulder Clay
Nar Valley Clay
Southern limit of Hunstanton Boulder Clay
Eastern limit of Little Eastern Chalky Boulder Clay
Line of contact of Great Eastern Chalky Boulder Clay with Great Eastern Jurassic Boulder Clay

REFERENCES.

Baden-Powell, D. W. F. (1948a). "Long Distance Correlation of Boulder Clays." *Nature, 161*, 287.

Baden-Powell, D. W. F. (1948b). "The Chalky Boulder Clays of Norfolk and Suffolk." *Geol. Mag., 85*, 279.

Baden-Powell, D. W. F. (1950). "Field Meeting in the Lowestoft District." *Proc. Geol. Assoc., 61*, 23.

Baden-Powell, D. W. F. & Moir, J. R. Reid (1938a). "A Palaeolithic Industry from the Cromer District." *Nature, 142*, 912.

Baden-Powell, D. W. F. & Moir, J. R. Reid (1938b). "On a New Palaeolithic Industry from the Norfolk Coast." *Geol. Mag., 79*, 209.

Blake, J. H. (1890). "Geology of Yarmouth and Lowestoft." *Mem. Geol. Surv. Engl. Wales*, Sheet 67.

Boswell, P. G. H. (1923). "The Geology of the Country around Cromer and Norwich." *Proc. Geol. Assoc., 34*, 207.

Boswell, P. G. H. (1931). "The Stratigraphy of the Glacial Deposits of East Anglia in relation to Early Man." *Proc. Geol. Assoc., 42*, 87.

Boswell, P. G. H. (1932). "The Contacts of Geology: the Ice Age and Early Man in Britain." *Rep. Brit. Assoc., 57.*

Boswell, P. G. H. (1935). "Geology of the Norwich District." *Rep. Brit. Assoc.*, Appendix, 49.

Boswell, P. G. H. (1936). "Problems of the Borderland of Archaeology and Geology in Britain." *Proc. Prehist. Soc., 2*, 49.

Boswell, P. G. H. (1952). "The Pliocene-Pleistocene Boundary in the East of England." *Proc. Geol. Assoc., 63.*

Brydone, R. M. (1906). "Stratigraphy and Fauna of the Trimingham Chalk." *Geol. Mag.*, Decade 5, *3*, 124.

Bull, A. J. (1942). "Pleistocene Chronology." *Proc. Geol. Assoc., 53*, 1.

Burnaby, T. P. (1950). "The Tubular Chalk Stacks of Sheringham." *Proc. Geol. Assoc., 61*, 226.

Chatwin, C. P. (1937). "East Anglia and adjoining areas." *Geol. Surv. U.K., British Regional Geology.*

Farrington, A. & Mitchell, G. F. (1951). "The End Moraine of Flamborough Head." *Proc. Geol. Assoc., 62,* 100.

Harmer, F. W. (1902). "A Sketch of the Later Tertiary History of East Anglia." *Proc. Geol. Assoc., 17,* 416.

Harmer, F. W. (1910). "The Glacial Deposits of Norfolk and Suffolk." *Trans. Norf. & Norw. Nat. Soc., 9,* 108.

Hopwood, A. T. (1940). "Fossil Mammals and Pleistocene Correlation." *Proc. Geol. Assoc., 51,* 79.

Kennard, A. S. in Bull, A. J. (1942), pp. 24, 25.

Kirkaldy, J. F. (1939). "History of the Lower Cretaceous Period in England." *Proc. Geol. Assoc., 50,* 379.

Maw, G. (1869). "On the Sequence of the Deposits in Norfolk and Suffolk superior to the Red Crag." *Rep. Brit. Assoc.* for 1868 (Norwich Meeting), *Trans. of Sections,* 73.

Moir, J. R. Reid (1923). "An Early Palaeolith from the Glacial Till at Sidestrand." *Ant. Journ., 3,* 135.

Oakley, K. P. in Bull, A. J. (1942), pp. 30—31.

Paterson, T. T. (1939). "Pleistocene Stratigraphy in Breckland." *Nature, 143,* 822.

Reid, C. (1882). "Geology of the Country around Cromer." *Mem. Geol. Surv. Engl. Wales,* Sheet 68 (E).

Reid, C. (1890). *The Pliocene Deposits of Britain.*

Reid, C. (1913). *Submerged Forests.* Camb. Univ. Press.

Sainty, J. E. (1929). "The Problems of the Crag." *Proc. Prehist. Soc. E. Ang., 6,* 57.

Sainty, J. E. (1949). "The Trimingham Chalk." *Proc. Geol. Assoc., 60,* 216.

Skertchly, S. B. J. (1877). "Geology of the Fenland District." *Mem. Geol. Surv. Engl. Wales.*

Solomon, J. D. (1932a). "The Glacial Succession on the North Norfolk Coast." *Proc. Geol. Assoc., 43,* 241.

Solomon, J. D. (1932b). "Mineral Assemblages of the Great Chalky Boulder Clay and Cannon Shot Gravels of East Anglia and their significance." *Geol. Mag., 69,* 314.

Solomon, J. D. (1933). "Implementiferous Gravels in East Anglia." *Proc. Prehist. Soc. E. Ang., 7,* 177.

SOLOMON, J. D. (1935). "The Westleton Series in East Anglia: its age, distribution and relations." *Q.J. Geol. Soc., 91.*

STEERS, J. A. (1942). "The Physiography of East Anglia." *Trans. Norf. & Norw. Nat. Soc., 15,* 231.

STEERS, J. A. (1946). *The Coastline of England and Wales.* Camb. Univ. Press.

WOLDSTEDT, P. (1950). "A Comparison of the East Anglian and Continental Pleistocene." *Nature, 165.*

WOODWARD, H. B. (1881). "Geology of the Country around Norwich." *Mem. Geol. Surv. Engl. Wales,* Sheets 66 N.E. and S.E.

WOODWARD, H. B. (1884). "Geology of Fakenham, Wells and Holt." *Mem. Geol. Surv. Engl. Wales,* Sheet 68 N.W.

ZEUNER, F. E. (1935). "The Pleistocene Chronology of Central Europe." *Geol. Mag., 72,* 350.

ZEUNER, F. E. (1937). "A Comparison of the Pleistocene of East Anglia with that of Germany." *Proc. Prehist. Soc., 3,* 136.

ZEUNER, F. E. (1946 & 1950). *Dating the Past.* London, Methuen.

III

WILD BIRD PROTECTION IN NORFOLK IN 1951

Report of the Council (in Part)

CLEY BIRD OBSERVATORY.

The Observatory's second year ended on September 30th, 1951, thus conforming as before with the official year of the Bird Ringing Committee at the British Museum (Nat. Hist.), London. Each ring is stamped with this address in addition to a serial number.

The main work has again been the ringing of both passage migrants and breeding species, though the total was rather smaller than last season (1,060 birds of fifty-seven species as against 1,254 of sixty species). (N.B.—twenty-two bramblings and two oyster-catchers were unfortunately omitted from last season's list.) This season's smaller total is attributable to two main factors ; namely the dearth of winter snow-buntings and the unavoidable reduction in time spent searching for nestlings fit to be ringed. The ringing of black-headed gulls has also been suspended as the specified ring is, in our opinion, unsuitable.

The total of 1,060 birds is made up of 671 trapped birds and 389 nestlings. Among the more interesting captures may be mentioned five snow-buntings, fifteen bramblings, fifteen pied flycatchers, three black redstarts and five dunlins.

The " cover " situation was greatly improved by the introduction of a series of temporary " bushes " of brushwood and rhododendron branches strategically arranged in a chain that terminates in the trap. By this means small birds can be shepherded from bush to bush for a considerable distance (400 yards is the record to date !). This does not mean that our intensive planting operations have failed entirely, for while many shrubs and trees have died, several seem to have gained the upper hand of the merciless westerly winds and sea-buckthorn, tree lupin, elder, *suaeda fruticosa*, willow, birch, hawthorn, blackthorn, poplar and tamarisk are giving cause for optimism.

The original " Heligoland " trap on Cley Beach (now fitted with a second catching-chamber), has again accounted for most

of the trapped birds, while clap-nets and " maze " traps were successful in catching several species including over 100 starlings. A smaller " Heligoland " trap was constructed during the spring on a site where piles of rubble attract passing wheatears, but the main movement was over before the trap was in working order and very few birds were caught.

Two small wader traps were in operation on a non-tidal pool behind the beach, but did not come up to expectation. Only five dunlins and one ringed plover were trapped. Turnstones, common sandpipers and green sandpipers were narrowly missed.

Special mention must be made of the kindness of Mrs. R. F. Meiklejohn, Miss Judith Ferrier and Capt. R. Buxton in placing their new " Heligoland " trap at our disposal. It was built during the summer in a sheltered blackthorn thicket on the Salthouse boundary and caught over twenty birds before the roof was finished ! It has a most promising future.

Over fifty-two more meadow-pipits were colour-ringed to help the Warden in his study of this species and at least four of last year's birds returned to nest in the area, a high recovery percentage for a small passerine, again emphasising the value of colour-ringing (see " Recoveries "). A breeding pair, of which both sexes are colour-ringed, has yet to be located.

Ectoparasites were collected from birds trapped or found dead and submitted to Miss Theresa Clay of the Department of Entomology at the British Museum for identification. We are grateful to her for taking so much trouble. The last species include starling, mistle-thrush, fieldfare, snow-bunting, shelduck, guillemot, ringed plover, kittiwake, kestrel, coot, woodcock, skylark, house-sparrow, goosander, water-rail, swallow, carrion-crow, chaffinch and little gull. Details will be sent to anyone interested.

At the end of September the Observatory acted as host to the eleventh meeting of the Bird Observatories Committee, when representatives of the eight other ringing stations in the country discussed future plans and the work of the past year. Coloured films of Fair Isle, Gibraltar Point and the R.S.P.B's sanctuaries at Havergate Island and Minsmere were shown through the kindness of Mr. Clifford Holt. The Committee members visited the Observatory the following morning.

A number of visitors and friends have given very welcome help during the year and we are most grateful to them.

RINGING PROGRESS.

Species	Season 1949–1950	Season 1950–1951			Grand Totals
		Trapped	Nestlings	Total	
Starling	26	118	0	118	144
Greenfinch ...	76	42	5	47	123
Goldfinch	1	1	7	8	9
Linnet	66	69	9	78	144
Chaffinch	67	49	3	52	119
Brambling ...	22	15	0	15	37
Yellow Bunting ...	11	2	0	2	13
Reed-Bunting ...	31	8	3	11	42
Snow-Bunting ...	143	5	0	5	148
House-Sparrow ...	112	94	0	94	206
Tree-Sparrow ...	24	0	2	2	26
Wood-Lark ...	8	0	1	1	9
Skylark	47	3	26	29	76
Tree-Pipit ...	0	0	3	3	3
Meadow-Pipit ...	51	4	48	52	103
Rock-Pipit ...	5	0	0	0	5
Yellow Wagtail ...	9	0	6	6	15
Pied Wagtail ...	5	2	0	2	7
Great Tit	13	6	9	15	29
Blue Tit	43	71	2	73	116
Coal Tit	9	0	0	0	9
Red-backed Shrike	5	0	10	10	15
Spotted Flycatcher	6	0	1	1	7
Pied Flycatcher ...	6	15	0	15	21
Goldcrest	1	1	0	1	2
Willow-Warbler ...	20	17	0	17	37
Reed-Warbler ...	5	0	8	8	13
Sedge-Warbler ...	11	0	5	5	16
Blackcap	6	2	0	2	8
Whitethroat ...	20	35	13	48	68
Lesser Whitethroat	2	4	0	4	6
Fieldfare	0	2	0	2	2
Mistle-Thrush ...	0	2	0	2	2
Song-Thrush ...	60	7	52	59	119
Redwing	0	1	0	1	1
Blackbird	96	30	62	92	188

Species	Season 1949–1950	Season 1950-1951 Trapped	Nestlings	Total	Grand Totals
Wheatear	21	14	2	16	37
Whinchat	1	1	0	1	2
Redstart	2	8	4	12	14
Black Redstart ...	7	3	0	3	10
Nightingale ...	5	0	8	8	13
Robin	47	23	8	31	78
Hedge-Sparrow ...	35	6	22	28	63
Wren	3	3	1	4	7
Swallow	11	0	27	27	38
House-Martin ...	4	0	3	3	7
Swift	0	0	2	2	2
Nightjar	2	0	0	0	2
Cuckoo	0	0	1	1	1
Little Owl ...	2	0	0	0	2
Barn-Owl	5	0	2	2	7
Bittern	2	0	0	0	2
Sheld-duck ...	1	1	0	1	2
Wood-Pigeon ...	1	0	0	0	1
Stock-Dove ...	2	0	1	1	3
Turtle-Dove ...	2	1	0	1	3
Woodcock ...	1	0	0	0	1
Dunlin	1	5	0	5	6
Redshank ...	13	0	7	7	20
Ringed Plover ...	23	1	15	16	39
Lapwing	16	0	3	3	19
Oyster-Catcher ...	3	0	4	4	7
Common Tern ...	2	0	3	3	5
Little Tern ...	5	0	0	0	5
Black-headed Gull	29	0	0	0	29
Razorbill	1	0	0	0	1
Guillemot	0	1	0	1	1
Totals	1,254	671	389	1,060	2,314

1949—1950 : 60 species.
1950—1951 : 57 species
1949—1951 : 67 species.

RECOVERIES.

(All were ringed at Cley unless otherwise stated).

STARLING

Female, RK 775, ringed 10.12.50; caught at nest in Schleswig-Holstein, May, 1951 (released less ring).

Female, RK 786, ringed 25.1.51; found dead at Bungay, Suffolk, 25.3.51.

Female, RK 804, ringed 3.2.51; re-trapped at roost on Salthouse Heath, 25.2.51.

Male, RK 806, ringed 3.2.51; shot at Hempnall, Norfolk, 16.3.51.

LINNET

Juvenile, NF 0695, ringed 20.6.51; found dead at Blakeney, 11.7.51.

Juvenile, NF 0753, ringed 29.6.51; found dead at Morston, Norfolk, end of August, 1951.

CHAFFINCH

Male, F 7661, ringed 18.11.49; re-trapped at roost on Salthouse Heath, 11.3.51.

Male, F 7905 colour-ringed 21.2.50; wintered at Observatory 1950-51, next seen 18.10.51 and subsequently.

Female, L8290, ringed 3.3.51, re-trapped 31.10.51.

(These are almost certainly wintering birds of the Continental race)

SKYLARK

Male, F 7913, colour-ringed 25.2.50; nested where ringed, 1950, 1951.

MEADOW-PIPIT. (Local birds are probably all summer residents, one having been recovered in Portugal after the breeding season some years ago.)

J 5721, colour-ringed as nestling, 20.5.50; nested at Weybourne (3 m. E.), 1951.

J 5733, colour-ringed as nestling, 23.5.50; first seen on nesting territory on 4.4.51.

Male, J 5734, colour-ringed as nestling, 23.5.50; first seen on nesting territory on 4.4.51.

J 6030, colour-ringed as adult, 18.6.50; first seen on nesting territory on 4.4.51.

Blue Tit

Male, F 7663, ringed 20.11.49 ;. nesting where ringed, 1951.

L 4497, trapped at Sheringham by P. R. Clarke, 10.11.50; found dead at Framingham Pigot (26m. S.S.E.) 2.3.51.

Spotted Flycatcher

K 5481, ringed as nestling at Horstead by Messrs. Ash & Ridley, on 16.7.50; recovered Cadiz, Spain, 24.10.51.

Blackbird

Female, SV 584, ringed as emigrant, 21.3.50; found dead Wittmund, Ostfriesland, Germany, 2.4.51.

Wheatear

Male, F 7964, colour-ringed with his 1950 mate on 13.4.50, returned to same breeding territory, 28.3.51, but took an unringed female.

(N.B.—Despite abundance of apparently suitable rabbit burrows and presence of new female, a cavity under a concrete slab on the beach was again occupied, suggesting the nest-site was selected by the male). Rings were bright as new.

Nightingale

NJ 946, ringed as nestling, Weybourne, 10.6.51, by P. R. Clarke; re-trapped at Salthouse (3 m. W.), 12.8.51.

Hedge-Sparrow

F 7548, ringed Salthouse, 2.10.49; re-trapped where ringed, 2.8.51.

Ringed Plover

Male colour-ringed as a chick, 2.6.49; seen 23.6.50 and again during 1951.

Lapwing

Female, 252848, ringed as a chick at Salthouse, 5.5.50; found dead at Cley, 1.5.51, a fully-developed egg in the ovary providing evidence of first summer breeding.

Redshank

Paris Museum GG 5537, ringed St. Vivien de Médoc in Bordeaux area, 28.3.49 on migration; found dead Blakeney, 7.5.51.

R. A. Richardson,
(Warden.)

EXCEPTIONAL MIGRATORY RUSH AT CLEY.

In the course of the first three days of October, 1951, a very large movement of birds was observed at Cley.

The last few days of September consisted mostly of fair weather with easterly winds, due to the existence of an anti-cyclone over Norway.

During the night of September 30th/October 1st, a steady easterly wind prevailed, accompanied however by considerable low cloud, which conditions continued during the day of October 1st but, with the exception of a few chaffinches and redstarts, nothing of particular interest occurred during the morning of that day. About 1 p.m., however, the ruins of the camp at the end of the Beach Road at Cley and the bushes and buildings between the road and the Observatory were suddenly swarming with robins ; it was estimated that there were at least 200 in the camp buildings alone, in addition to vastly larger numbers in the grass, the bushes and buildings in the neighbourhood of the Observatory. By evening 102 robins had been ringed by the Warden and his Assistants.

In the course of the afternoon many robins were observed coming in from the sea in a very exhausted condition and could have been picked up by hand ; one bird, in particular, was seen to come in very low over the water and, being unable to gain elevation, to collide with a low ridge of shingle just above the tide mark.

Between 3 p.m. and 5 p.m. on the same day the bushes suddenly became alive with goldcrests and song thrushes, although these were not actually seen to come in from the sea.

On October 2nd, after a night of continued medium to strong easterly winds and cloud, I went along the Beach towards Blakeney Point. In the bushes from the Hood to the Long Hills were masses of birds consisting of very large numbers of robins, song thrushes, goldcrests (among which one firecrest was observed), a fair number of redwings, fieldfares, bramblings, chaffinches, redstarts, willow wrens and/or chiffchaffs, blackcaps (male and female), one ring ousel (cock), some

snow-buntings, two Lapland buntings (identified by call only) and five bluethroats, one of which was in practically full spring plumage with blue breast and red spot.

The following day, October 3rd, was fine and cloudless, with a steady east wind, after a night of similar conditions. The Hood, the Long Hills and the Britannia Point produced a great many robins and goldcrests (but less than on the previous day) and very much larger numbers than previously of song thrushes, redwings, fieldfares, with a fair number of blackbirds, twenty to thirty ring ousels, some bramblings, chaffinches, blackcaps, redstarts, a few willow wrens and or chiffchaffs, one pied flycatcher, one spotted flycatcher, one merlin, and two bluethroats (immature). The small plantation on the Point, near the Laboratory, was beaten and produced (simultaneously) twenty to twenty-five goldcrests, eight ring ousels, a few willow wrens and/or chiffchaffs and one short-eared owl.

By the following day, October 4th, with similar weather conditions, most of the birds appeared to have passed on.

There are of course on record many cases of migration on as large or larger a scale and productive of more and much greater rarities, but two points of interest emerge in the present instance, i.e. :—

(1) that during the spell of easterly winds, it was only when these winds were accompanied by low cloud and mist that very large numbers of many species of birds were observed ;

(2) that robins were seen actually coming in from the sea during the middle of the day, while, judging from the time at which they appeared, everything pointed to the song thrushes and goldcrests having done so as well, although this was not actually observed.

A. H. Daukes.

CLASSIFIED NOTES.

Contributors.

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E. A. Ellis, Miss B. Everitt, S. Everitt, P. L. Garrett, P. J. Hayman, Harold Hunt, Miss C. James, Paul Kirby, Capt. L. Lloyd, G. Marsham, Mrs. R. F. Meiklejohn, Mrs. Palmer, John Parker, E. Piggin, R. A. Richardson, C. C. Rose, Michael Seago and W. Wince.

Hooded Crow

An early arrival at Cley July 15th (W. B.). Another, probably a late bird of previous winter, over Breydon Water May 5th (M. S.).

Golden Oriole

One in House Hills, Scolt Head, on November 10th (R.C.)

Crossbill

Two pairs near Brandon on September 16th (C. C. R. and W. W.).

Twite

A party of forty seen regularly at Breydon during the winter up to March 4th. The latest spring record was March 24th (M. S.).

Lapland Bunting

One identified at Cley September 30th (R. A. R.). Also one at Cley feeding with snow-buntings October 28th (M. S.). Four seen October 2nd—6th in the Blakeney/Cley area (H. H.). Two still in Blakeney area November 26th (H. H.).

Little Bunting

On September 20th one was seen on the East bank of the Cley marshes feeding on weed seeds with a party of small birds. The following description is a summary of those made by the four observers, Lady Jones, Miss Almack, Miss Crossby and K. V. Elphinstone.

Size: smaller than a reed-bunting, larger than a goldfinch.

Head: chestnut brown mottled black, very noticeable yellow stripes above and below the eye, the lower one being moon-shaped.

Back and rump: chestnut brown with darker primaries, underparts pale buff.

Tail: distinctly shorter than those of the reed buntings in the party with white outer tail feathers showing in flight.

Characteristics: A compact neat little bird and very lively.

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Waxwing Drinking, Cley Marsh.

R. P. Bagnall-Oakeley

Skins of little buntings have been examined confirming the observations made.

ORTOLAN BUNTING

An immature at the Hood, Blakeney Point September 7th (R. A. R.). Also one seen by several observers in the plantation on the Point September 21st.

ROCK PIPIT

A few seen regularly at Breydon up till March 24th. An early date for one returning there, September 30th (M. S.).

BLUE-HEADED WAGTAIL

One at Walberswick April 21st (M. S.). One at Hickling May 15th (G. B.). One feeding on a grazing marsh Cley May 11th (C. C. R.).

GREY WAGTAIL

At least five pairs spent the summer in Norfolk in the following localities :—

Hellesdon Mill : One pair bred and reared four young. One bird seen mid-November and still present on Dec. 9th.

Marlingford Mill : A pair bred successfully.

Trowse Mill : A male seen in May and June ; also in November. No evidence of nesting. One seen on Dec. 9th.

Stoke Holy Cross Mill : A pair seen end of May ; no proof of nesting.

Runhall Bridge, River Yare : A nest found by Mr. Q. E. Bitton on a ledge beneath the bridge.

Taverham Mill : Birds seen, but no evidence of nesting (M. S.).

City Station Bridge, Norwich : One seen March 1st (H.G.B.)

WHITE WAGTAIL

A splendid adult on Breydon Marsh April 22nd (M. S.). One at Salthouse Marsh September 10th ; also adult male seen October 2nd—6th (H. H.).

GREAT GREY SHRIKE

One at Cley March 30th (Mrs. Palmer). Also one on Salthouse Heath from October 20th—November 6th. Two were seen there on October 21st, when one routed a Little Owl by vigorous " dive bombing " attacks and agressive display with flapping wings and spread tail. (C. C. R.). One at Boughton on December 13th, seen in flight and perched on a hedge (J.P.)

Waxwing

Three flew in from sea, Scolt Head January 9th (R. C.). Two at Burnham Overy January 21st (S. E.). Two in a Caister garden feeding on cotoneaster January 25th, and two eating haws, Hellesdon January 27th (M. S.). Two at Hellesdon February 5th (H. G. B). Two at Cley January 26th and one on February 5th ; also five on November 15th (W. B.). Five on Runhall Common November 25th (Q. E. B.). A small party seen frequently at Wheatfen during December (E. A. E.)

Red-Breasted Flycatcher

A female seen at Cley on August 26th by A. & C. Hitchon. A convincing description was given to R. A. Richardson.

Blackcap

A wintering bird was seen feeding on bread in my garden at Sheringham on January 15th. It was in good plumage and general condition. Later it was trapped and ringed (L 4512 also red plastic ring on right leg) (P. R. C).

Icterine Warbler

. On September 6th, during rush of migrants on a north-east wind, one in Suaeda bushes at the Hood, Blakeney Point (Mrs. R. F. M.). One in Blakeney Point plantation September 5th, which stayed three days (W. E. E.).

Subalpine Warbler

On June 11th at the Cley Bird Observatory a small bird was seen to dive into some barbed wire. It was easily flushed and recognised as a male subalpine warbler. It was driven into the trap but unfortunately this was under repair and the bird escaped. The following description was obtained whilst the bird was sheltering in a bush from the strong east wind. Bill dark, yellowish at base. Eye noticeably red. Whole of upper parts blue-grey, deepest on head. Wings grey-brown, primaries darker, secondaries edged light buff. Tail browner than upper parts, outer tail feathers faintly tinged buff. A thin but distinct white moustachial stripe from the base of the bill separated the grey of the upper parts from the pink of the under parts, this being deepest on the throat and fading out on the flanks. Under tail-coverts white

faintly washed dull yellow. Feet bright yellow-flesh. The bird was last seen by R. A. R. at 7 p.m. This is the first record for Norfolk and England (P. J. H. & R. A. R.).

N.B.—Single males were ringed on Fair Isle May 23rd and June 9th, 1951.

[Eversmann's Warbler.]

The following is a field description of a " leaf-warbler " seen in the Suaeda bushes near Blakeney Point on September 21st, 1951 :--

Size : slightly larger than willow-warbler. A prominent sulphur-yellow supercilliary stripe was broadest above the ear-coverts and extended almost to the nape. Below this was a dark streak in front of and behind the eye. The crown was olive-green while the mantle was dark brownish-green with the wings and tail dark brown. Across the wing was a narrow but noticeable pale yellow bar. There was no contrast in colour between the rump and the mantle. Although the whole of the underparts were not seen thoroughly they appeared whitish. The legs were brownish and paler than the bill, which was noticeably long (L. P. A.)

Aquatic Warbler

One in a reedy pool at Blakeney on September 8th. The following characteristics were observed : Centre of crown buff bordered by black lines and thin yellow-buff stripe over eye. Chin : whitish ; breast buff with some dark streaks ; rump tawny marked dark ; tail dark brown and tawny. Bill brownish ; legs light flesh. The bird was watched for half an hour as it moved among the reeds about a foot above the water. On two occasions it raised its tail vertically like a red-breasted flycatcher (Miss C. James, C. C. R. and W. W.).

Grasshopper Warbler

One, in song, both seen and heard on the Beach Road, Cley September 10th (A. H. D.).

Redwing

One at Caister April 22nd, singing in a tall willow tree. It appeared to be in full song, three or four flute-like notes followed by a low warbling (M. S.). Eight seen on Blakeney Marshes September 29th, early autumn arrivals (H. H.). Five found

dead on South Marine Parade, Yarmouth, on the morning of October 12th. They appeared to have collided with overhead cables as they flew in from the sea during the foggy night (R. H.).

Ring Ousel

Two on passage, Caister April 24th (M. S.). One at Scolt Head April 23rd and two on May 8th (R. C.). One at Blakeney Point Hood September 21st and twenty to thirty on the Point on October 3rd (A. H. D.). On October 3rd a male was picked up so badly mauled by a cat that it had to be destroyed (Dr. Ley). On October 4th one in orchard, Blakeney ; three in garden October 5th ; and on October 6th eight were put up from Blakeney Point plantations and were seen later near the Hood with blackbirds, redwings and Continental robins (H. H.).

Redstart

A pair nested on Salthouse Heath for the third year in succession. Four nestlings were reared from a clutch of five eggs laid in the same hole as last year (R. A. R.).

Black Redstart

Only one pair found nesting in Yarmouth this season. On June 27th the nest contained four nestlings. The adult birds were last seen in the vicinity of the nest on September 18th (R. H.). An immature male seen several times in June among bombed buildings at Yarmouth (M. S.). A male singing in Cromer June 14th ; a juvenile ringed at Cley July 22nd (R. A. R.). A male seen at Cley September 8th (A. H. D.).

Red-spotted Bluethroat

One in House Hills, Scolt Head September 10th (R. C.). One by the Hood, Blakeney Point on September 9th and 11th. Two on the Yankee Ridge B.P. on September 11th (several observers). One at Blakeney Point September 13th, and another on September 18th (H. H.). On October 2nd in bushes between the Hood and the Long Hills, Blakeney Point, five seen, one of which was in practically full spring plumage with blue breast and red spots (A. H. D.). One at Cley October 5th (W. B.). Four seen Blakeney Point October 2nd, and two on October 3rd (W. E. E.).

CONTINENTAL HEDGE-SPARROW

On October 4th a hedge-sparrow was trapped and ringed at Cley which had pale grey under parts, the longer second primary and the shorter seventh of the Continental race (*Prunella m. modularis*). One or two similar birds were recorded at the same time when the " rush " of robins was in progress. There appears to be only one previous record of this sub-species in Norfolk (see Riviere " History of the Birds of Norfolk "), but there can be little doubt that it is a regular winter visitor (R. A. R.).

NIGHTJAR

One at Scolt Head May 7th, resting on the pebbles behind the Hut (R. C.). One at Cley May 15th (W. B.).

WRYNECK

On May 11th one seen feeding with a blue-headed wagtail on a grazing marsh at Cley (C. C. R.). One in Suaeda bushes near Watch-house, Blakeney Point, on September 6th (P. K. and P. C.).

PEREGRINE FALCON

One flying east between Morston and Blakeney on November 18th was seen to stoop at and kill a redshank (H. H.).

ROUGH-LEGGED BUZZARD

Splendid views of one on a Breydon marsh on April 15th. It flew only a short distance when closely approached and alighted first on a gate-post and later on the dyke-wall (M. S.). " A hawk with feathers down to its toes " seen by two lads on Burnham Overy marshes January 25th (R. C.).

HOBBY

A male seen June 2nd, off Sheringham cliffs, carrying what appeared to be a mouse (G. M.). One over Cley marshes June 3rd (P. J. H.).

OSPREY

The first spring arrival at Hickling stayed from April 8th—12th. Another remained from May 19th—29th. This bird was frequently seen fishing and appeared to quarter its fishing area systematically. A third was seen on July 11th (E. P. and G. B.). One seen flying down Blakeney Harbour on May 18th (W. E. E.). One flying west along Cley beach June 8th (P. J. H.).

SPOONBILL

On June 2nd one on Salthouse marshes was watched by Colonel O. Birkbeck and Lt.-Colonel H. J. Cator for over an hour. It was seen the following day by W. Bishop. A single bird at Hickling on June 14th did not stay (G. B.). Spoonbills were present on Breydon Water for eight consecutive weeks. Four arrived on June 18th and by July 1st there were seven. These remained three weeks when four left. The remaining three stayed on until August 13th. They were quite undisturbed by pleasure boats and other craft. On July 15th I watched two adults preening each others crests, neck and breasts for ten minutes. Later two younger birds, one with a slight crest, gave a similar performance (M. S.).

PURPLE HERON

Between May 10th and 12th an immature bird of this species at Cley was watched by several observers and careful notes made of its plumage and characteristics. Its voice was similar to that of the common heron but higher pitched. It kept to the dense reed-beds near the east bank (R. A. R.).

WHOOPER SWAN

On January 4th a party of ninety-four arrived on Hickling Broad. They were joined by forty-six more the following day which stayed only one night. The rest left a few days later. (E. P. and G. B.).

BEWICK'S SWAN

Ten at Cley on March 1st and a single bird on March 21st (W. B.).

WHITE-FRONTED GOOSE

The estimated number on Halvergate and Breydon marshes at the end of 1950 was 1,500. These left early in the New Year and were not seen after January 27th, 1951 (R. H.).

PINK-FOOTED GOOSE

These show a preference for the Bure marshes. There were four to five hundred on Breydon marshes and were last seen here on February 18th (R. H.).

BEAN GOOSE

Five at Blakeney on January 15th. One was shot the same evening and brought to me for identification (W. E. E.).

Approximately 120 seen feeding on the Buckenham marshes on February 14th (R. H.).

GREY LAG-GOOSE

January 17th, four flying down the creek from Overy to Brancaster. Three on the fresh-water marshes, February 20th (R. C.). A pair at Breydon February 18th (R. H.).

(N.B.—These birds may have come from those bred by Lt.-Colonel H. J. Cator and Mr. C. Gowing).

SNOW GOOSE

One was seen on November 23rd flying low over the Burnham Overy marshes in a north-east direction. It was clearly visible with white plumage, black flight feathers, red legs and bill. It turned towards the east end of Scolt Head but it could not be seen whether it came down on the island or went on out to sea (Miss B. Everitt).

(N.B.—There are snow geese at Woburn and also on the Severn Wildfowl Trust's reserve).

BRENT GOOSE

There were fewer in Blakeney Harbour than usual in January (W. E. E.). A party of 150 to 200 were in Brancaster Harbour on January 12th. On March 5th about 150 were seen flying east out at sea (R. C.).

BARNACLE GOOSE

Twelve at Cley on January 20th (W. B.). One on Hickling Broad March 29th (E. P.).

PINTAIL DUCK

Thirty-six on Breydon Water March 4th. At least one pair bred on the same marsh as in the previous two years. A nest with ten eggs was found on April 21st. On April 29th it was apparent that a horse grazing on the marsh had trodden on it destroying the eggs (R. H.).

SCAUP

On August 25th two pairs alighted on the lake at Taverham Mill and the two drakes and one of the ducks were shot. The duck was an immature but the drakes were both adult birds. This is an exceptionally early date (L. L.).

Ferruginous Duck

One identified on Brinton Lake on November 11th and 12th (R. P. Bagnall-Oakeley).

Long-tailed Duck

An immature flying west along Cley beach November 20th (C. C. R. and W. W.). Probably the same bird in Cley Channel November 24th (P. Jackson). One in Brancaster harbour, November 15th and 23rd (R. C.).

Eider Duck

A party of seven, four males and three females were in the Cockle-bight drain, Scolt Head, on May 1st. They remained in the harbour until May 8th (R. C.).

Smew

Five red-headed birds on Hickling Broad on February 9th and four on February 25th. A fine white drake seen on March 1st (G. B.).

Gannet

A dead bird found on the shore of Scolt Head Island which was attached to a hook and line. This with the weights were tangled round the wing so that the bird was unable to fly or to catch food (R. C.).

Leach's Fork-tailed Petrel

One seen flying west along Cley beach during a strong north-east wind on September 7th. An injured bird blown inland to Sidestrand by northerly gale on October 22nd was brought to the Observatory and fed there for twelve days, but it did not survive (R. A. R.). On November 5th one was picked up at Blakeney by Mr. P. Green, identified by Ted Eales and later sent to the Norwich Castle Museum.

Manx Shearwater

One or two seen off Cley on most days during first half of September. Three seen September 18th (W. B.). One off Cley September 19th (A. D.).

Fulmar

The first arrivals were seen off Sheringham on January 21st. Thirty birds were present in March. Four pairs occupied the

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Montagu's Harrier at Nest, Hickling.

Dr. K. J. Carlson

ledges where they had bred in previous years but were disturbed by cliff-falls during April. Five pairs remained to sit about on ledges throughout June, but there was no evidence of breeding. All had left in July (G. M.).

Red-necked Grebe

One off Cley on April 24th was showing traces of summer plumage. It was seen by several observers (R. A. R.).

Slavonian Grebe

One on Hickling Broad May 16th (G.B.). One at Cley September 26th (H. H.). One off Scolt Head Island October 2nd (R. C.).

Stone Curlew

One flushed in the sandhills on May 10th, the first record for Blakeney Point (W. E. E.).

Black-tailed Godwit

A single bird at Cley April 24th (W. B.). One seen at Cley September 26th (H. H.).

Kentish Plover

Three seen on Cley beach at mid-day on September 11th. They were watched for half an hour under most favourable conditions. The dark, leaden legs and differences of plumage and behaviour distinguishing them from the ringed plover were most noticeable (P. L. G.).

Little Ringed Plover

One seen feeding on Arnold's Marsh, Salthouse on May 6th (R. A. R.). Three adults at Cley September 10th (A. H. D.).

Little Stint

The first noted for the season seen on September 10th at Cley (H. H.).

Spotted Redshank

Two at Hickling seen on May 4th and 5th (E. P. and G. B.). One at Cley April 13th and two on June 28th (W. B.). One at Cley August 27th (A. H. D.). One seen on September 19th, three on September 25th and several on September 26th all in the Blakeney Cley area (H. H.).

Avocet

One seen on Rush Hills, Hickling by David Cullum on May 6th. The bird stayed only a short time (E. P.).

Temminck's Stint

One identified at Cley April 19th (W. B.). One on Rush Hills, Hickling October 4th (E. P.).

Purple Sandpiper

One on Blakeney Point September 7th and 8th (P. W. P. B.). Four seen October 4th at Salthouse (A. H. D.).

Common Crane

First seen on May 21st flying over Breydon Water, mobbed by lapwings, redshanks and gulls. One leg was obviously injured. This bird was also seen in the Belton and Burgh Castle area in early June. An account of its stay at Horsey is described in Major Anthony Buxton's notes.

Black Tern

The majority of recorded visits were in May when black terns were at Seamere, Hingham, Rockland Broad, Taverham, Hickling, and Scolt Head.

Common Tern

Three pairs bred on the hulls of the two old wherries in Ranworth Broad.

Little Gull

One seen at Cley on May 13th and May 21st (W. B.). A second year bird at Cley on September 3rd. On September 10th three seen, one an adult in winter plumage, one a second year and the third a first year bird ; and on September 20th a bird showing more black throughout than the usual immature seen in autumn, probably a first winter bird (A. H. D.).

Sabine's Gull

The following description is of a Sabine's gull seen offshore from Cley beach on September 4th :—Head white with dark mark behind the eye ; nape dark ; bill black with dusty tip ; back and mantle slate grey ; forked tail white with dark terminal band ; breast and underparts white ; wings grey with characteristic black border and large white triangular secondary patch ; legs dark ; size somewhat smaller than nearby black-headed gulls. It occasionally fed off the surface of the water. The bird was watched for twenty minutes by myself, my wife, Miss James and Mr. Kidd. (C. R. R.).

Arctic Skua

Many were seen passing along the coast in September from Scolt Head to the Cley area. Two fine adults seen close inshore off Cley on October 28th (M. S.).

Great Skua

Three off Cley on September 19th (A. H. D.).

Black Guillemot

A bird that was probably an immature in moult was seen off Cley by several observers on September 16th. The white wing patches were noticeable (R. A. R.).

Little Auk

An exhausted bird, found at Happisburgh on December 12th failed to respond to efforts made to feed it. (E. A. E.).

Corncrake

One flushed at Cley on April 20th by Colonel Brownlow and W. Bishop. Another flushed from rough grass behind Cley beach on September 7th (C. C. R. and W. W.).

Spotted Crake

One seen several times between December 26th, 1950 and January 5th, 1951 in an osier carr at Brinton (R. P. B.-O.).

One seen near the East bank of the Cley marshes on December 1st (Mrs. R. F. M.).

ADDITIONAL RECORD FOR 1950

Broad-billed Sandpiper

Two small waders identified as the above were seen on September 5th, 1950, at close range in company with a large number of waders of several species feeding on the muds and shallow pools near the Watch-house on Blakeney Point. These birds were somewhat larger than the stints and smaller than the dunlin. The legs were short and black; the bill black, almost as long as a dunlin's and slightly stouter; the head, viewed from in front, appeared rather square and uptilted, the sides were pale; the crown was dark; there was a marked but not extensive pale supercilliary stripe; the chin was white; the mantle appeared rich in colour and dark streaked with pale edges; the throat was suffused pale brown thinly speckled; the upper breast ended in a clearly defined "pectoral" band which extended almost to the legs; the lower breast and belly were pure white (H. H.).

IV

RECENT CHANGES ON THE MARSHLAND COAST OF NORTH NORFOLK.

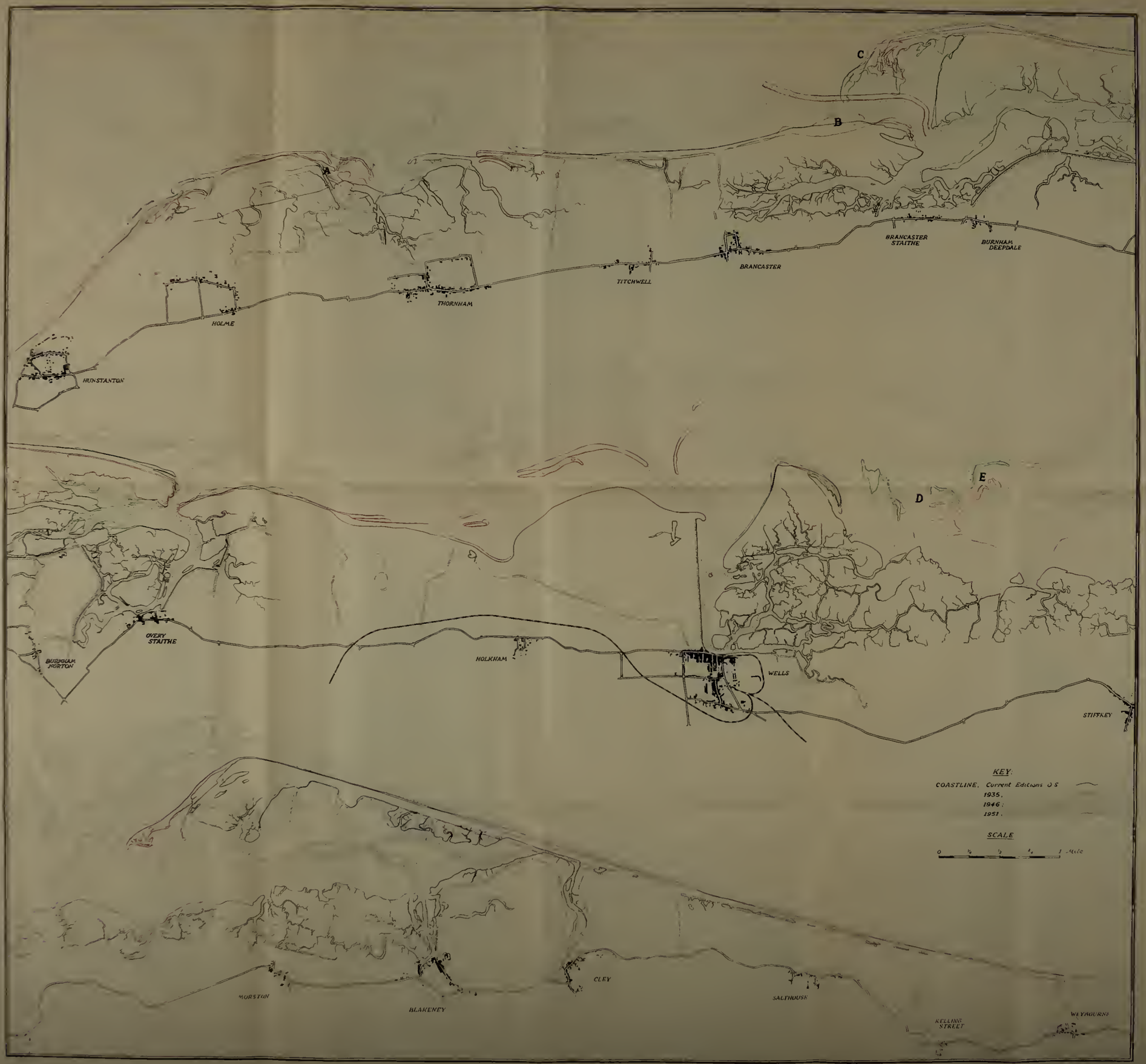
By J. A. Steers.

In June and July, 1951, a careful physiographical survey, accompanied by detailed mapping on the six-inch Ordnance Survey maps, was made of the coast between Hunstanton and Weybourne. This is part of a more extensive piece of work, but is nevertheless complete in itself. The writer had the great advantage of the collaboration of Mr. H. A. P. Jensen, of the Nature Conservancy, and most of the actual mapping was done by Mr. J. D. Adshead and Mr. J. S. Manaton.

Accounts of the various parts of this stretch of coast have been published from time to time (see bibliography), but this is the first time an attempt has been made to investigate the whole. Since there is little likelihood of any great change inside Scolt Head Island, Blakeney Point, or in other sheltered areas, and since, too, the time required to map all such areas in detail would be considerable, the changes described and discussed in this account apply to the outer coast only. It should, however, be emphasised that the inner parts were examined, and found to be generally consistent with the maps made before the war.

In order to make reference to maps easy, the various sections of the coast are described from west to east, and the changes refer both to the existing six-inch maps and, where relevant, to the surveys listed in the bibliography.

From Hunstanton cliffs to near Holme beach the shore has prograded, but north-eastwards from Beach Cottage the spit enclosing Holme marsh has been pushed farther inwards, and in the past fifteen years has from time to time been breached so that fans of sand and shingle have been thrown over the marsh within. The tip of the spit is well developed, and is but 20 to 30 yards from the dune-covered wall just inside Gore Point. The scour in the narrow channel when a strong tide is running is considerable and defence works—brushwood, groynes etc.—are extremely necessary. Gore Point itself has been cut into and is far more rounded than appears on the official maps.



Perhaps the most interesting and significant change in this part of the coast, however, is the development of a well-marked ridge in front of the dunes* (which in places cover a sea-wall) between Gore Point and Thornham. This ridge had begun to form before the war and its eastern extremity has been mapped on several occasions. In 1939 it extended westwards as a somewhat ill-defined ridge, but now it is definite and relatively fixed, and protects the dunes. The map shows that near its western end it is itself covered by low dunes which appear to be growing into a line of fore-dunes. Scattered dunes occur elsewhere, and sea-birds were nesting on the ridge. In its mid part it is scarcely separated from the main line of dunes, and its western extremity is low and grades into a sand flat. Further development on this ridge is likely to be interesting in itself, and also in its relation to Gore Point, and to the constant threat of erosion thereabouts.

Thornham West Island has not altered greatly in shape, but appears to have moved inwards. It was carefully surveyed four times before the war. It has become rather less crescent shaped, and a ridge (see map) has grown outwards from it, and now nearly reaches that one described in the previous paragraph. If this continues to grow the parts enclosed will remain well protected, although there has been some slight attack in recent years near the point marked A. On the other hand, marsh growth has extended considerably inside the island, and *Spartina stricta* has a hold, especially just inside its eastern end.

East of Thornham Harbour the changes that were at work before the war have continued. Thornham Middle Island has completely disappeared, and there is but an open beach, without any definite ridges, off all that part west of Green Lane and the Coastguard Station. Eastwards from that line a new ridge has been built, in many ways like the one between Holme and Thornham. It is a long and narrow structure, and its western end protects the part still remaining of Thornham East Island. How this foreshore will respond to the bombing on the new range remains to be seen.

*The present outer margin of the main dunes is about 30 yards in front of the embankment built to protect a weak place, and now under the dunes.

High water mark off Titchwell has been pushed landward, and the sea wall is useless. The western part is broken and nearly washed away ; there is a major breach in the middle, through which all tides flow, and springs cover all or most of the former reclaimed marshes. The breach was made in March, 1949. The ecological changes already noticeable are interesting and more careful attention to them would probably be worth while. Between the sea wall which continues the line of Gypsy Lane, and the Golf Club House the coast has been cut back, and the elaborate protection around the house and outbuildings has been justified. Eastwards from the Club House erosion of the beach is often to be related to the position of Brancaster Harbour Channel. If that swings southwards more effective wave action plays on the beach and erosion takes place. A comparison of the existing six-inch map and the mapping done this summer shows that along most of its length erosion has cut away the beach, especially in its mid parts. On the other hand, near the eastern extremity not only has there been some lengthening, but a new spit has grown up in front. Even more significant are the changes since Mr. Peel mapped this district in 1932. The dune ridge which he mapped at B has been washed away and the present outermost easterly ridge is in front of that existing in 1932. Undoubtedly many other changes have taken place, of which no record exists. It is, however, one of the many parts of this coast where continuous records would be both interesting and instructive.

The Far Point (i.e. western extremity) of Scolt Head Island was surveyed in more detail. As circumstances have made mapping difficult since 1939 no very useful comparison can be made with the series of maps published up to that year. There has been a fair amount of recent growth, and the Point proper is continued in a line of shingle patches covered at high water. On the other hand the long and narrow dune-covered ridge connecting the Far Point with the main mass of the island has been cut into on its seaward side. Since, however, much of the sand is blown over to the marsh side, the actual width has not varied so much. Near the point C, for example, the ridge is a good deal wider than is suggested at first sight by the position of the red line. This, however, is not the case near Anchor Marsh. Along the length of the island the same tendency is

apparent. The whole main line of coast has retreated and the seaward side of the big dunes near the Hut has altered a good deal. On the other hand, the small gaps between Hut and House Hills have for the most part healed, and small dunes have grown. But near the western end of Norton Hills there is now quite a serious break. This was, I think, partly made during the war, when this part of the dunes was the target end of an artillery range. Spring tides easily flow over the beach at this place, and a large fan of shingle and sand has been laid down on the marshes. A high tide and a strong blow from a northerly quarter might well lead to big changes hereabouts. Except for the paring away of the seaward face of Norton Hills, there is little change near Burnham Harbour. The tendency for a ridge, covered with dunes, to curve into the harbour from either side is still noticeable, but the general features have changed very little.

At and near Gun Hill there has been some give and take, but no very significant change. Farther to the east the shore is prograding. The dune edge is considerably farther seawards than on the 1929 edition of the six-inch map, and opposite Decoy Wood a new and well defined ridge has developed near to, but distinct from, the dune foot. The detailed mapping of the present edge of the dunes on either side of Holkham Gap was not attempted since the trees made resection impossible, and time did not permit of a series of traverses through the woods. Where measurements were made, the result was usually to show that there had been some slight advance—sometimes brought about partly by artificial means.

We are, however, far more concerned with features on the wide foreshore in front of the dunes. Low water mark off the eastern part of Holkham Meals may be a mile from the dune edge. On these extensive flats some particularly interesting new ridges have grown up in recent years, and are now recorded for the first time. About a third of a mile from Holkham Gap, and a little to the west of the centre line of the Bay, there are two of them, the inner one of which is now a pronounced dune ridge. On the outer ridge there are embryo dunes. The inner, and possibly the outer one also, owes some of its growth, and possibly its origin, to wire and other remnants of war-time beach defences. Now, however, they are both evolving in the usual way, and their growth should be recorded.

Off the eastern part of Holkham Woods there are two much bigger ridges, which, however, have at present little dune growth on them. In a sense they form a double ridge, since the outer and larger has for part of its length been thrown back on to the inner. The outer one is almost a mile long, and is in many ways similar to the Holme—Thornham ridge. It bends round at its eastern end and abuts on the channel of Wells Harbour as a high and conspicuous flat-topped ridge of mixed sand, shell, and shingle. There is a similar, complementary, but somewhat smaller ridge, which runs almost meridionally, just east of the harbour channel. It, too, terminates southwards in a high and well-developed sand and shingle end. All these ridges are still mobile and particularly the two outer ones. The fact that the inner ends of those on either side of the channel lie almost on its margin may be of significance, both to their own shape, and also to the maintenance of the position of the channel in that section of its course. The future evolution of both is worthy of study. Near the northern end of the ridge east of the channel there is a small isolated ridge which may possibly join later on to the main one.

Lodge Marsh Island is the third major structure on this coast—the two more important being Blakeney Point and Scolt Head Island. It is far more complex than the western island at Thornham. At one time part of the dune area was used as a farm, but the defences against the sea were inadequate. For many years it has been in a natural state. The trees planted on its western side have held the dunes to some extent, but erosion, partly by wind and partly by waves at high water, has undercut some of them. The west-facing side has thus retreated a little. The north-eastern arm has also suffered loss, but at the same time has lengthened slightly. The northern apex, somewhat unexpectedly, was found to have grown—in fact quite recent growth is obvious in the field since a number of new dunes occur there.

In 1937 Mr. Peel mapped the foreshore features between Wells and Blakeney Harbour. They also were carefully remapped this year. A comparison of the 1937 and 1951 maps is interesting. Three of the ridges mapped in 1937 have either maintained their position very closely, or else been replaced by

new features—the originals having disappeared. The former suggestion is the more likely to be true, although in 1937 some of the ridges were very immature and mobile. The same is still true, but it must be remembered that the distance between high and low water spring tides may be two miles off Stiffkey. The enormous stretches of sand exposed, and the shallow water which covers them for so short a period near high tide both militate against serious wave action taking place on them. Hence it is the more surprising that these ridges exist at all. If, as is assumed, the two patches of shingle marked D and E incorporate the thin and continuous ridges in this locality in 1937, it is clear that every now and again effective wave action does occur, but probably insufficient to cause major changes. The ridges marked D and E are now somewhat larger, but they show very little significant change. Farther west one or two new ridges occur, but it may well be that they were represented by a small flat of shingle in 1937, not worthy of being mapped as a ridge. This year a small flat near the south-eastern tip of Lodge Marsh Island was not mapped for this reason.

The more conspicuous inner ridges, called Stiffkey Meals, have altered but little. Here and there they have been eroded, elsewhere they have grown forward, but examination in the field suggested that further detailed mapping was unnecessary. An interesting point arises, however. At what stage were these inner ridges formed? They are often definite shingle ridges and carry low dunes and they may also be fronted by small shingle flats. The conditions under which they were formed are far from clear. The newer ridges on the outer flats are, in the writer's view, less shingly, being in fact mainly shell and sand ridges with usually a small proportion of stones. It is true that most of them carry a few drift line plants (*Salsola kali*, *Cakile maritima*, and perhaps *Agropyron junceum*), but they are, and seem long likely to remain, in a more elementary state than Stiffkey Meals. Does this possibly mean that since the Meals were formed the sand flats have increased in width and height so that wave action has become progressively less effective on the inner parts of the flats? Thin films of mud are spreading on large parts of the sand, a fact not inconsistent with this suggestion. A fuller analysis, however, of the conditions on these flats would be worth while.

Nearer Blakeney Point, and just south of Blakeney Pit, Morston Meals are somewhat more prominent. Toward Morston Creek there is some suggestion of a ridge having grown eastward and thrown off one or two laterals. Although developed on a far smaller scale than the ridges forming Brancaster Golf Course, these small Morston ridges bear a somewhat similar relation to Blakeney Point as do the Brancaster Links ridges to Scolt Head Island.

Blakeney Point was completely mapped in 1946 by Mr. Lee and Mr. Armour. Further detail on the outer coast was added by Mr. Peel and Mr. Grove in 1947. Since then there have been constant if minor changes. The Far Point has altered notably in detail but not in its main outline. The whole Headland area, and in fact the whole seaward length of the Point continues to retreat, chiefly as a result of occasional storms rolling pebbles right over the main beach. There is no evidence that the ridge has become any narrower. Alteration of this sort can be traced to Weybourne; beyond that place overrolling gives place to cliff erosion.

The changes and growths described in this account are not spectacular, but they are significant because they represent the result of slow and relatively stable conditions. The ridges at Holme and Thornham were there before the war; in the last decade, although they have moved, they have become more stable, and undoubtedly are having a major influence on the coast in front of which they stand. On the other hand, east of Thornham Harbour one small island has been washed away—the consummation of a process abundantly apparent in the thirties—and a new ridge is being built and is slowly extending westwards. All these new ridges are the direct product of wave action, and it is clear from an inspection that even if a meagre degree of stability characterises them, beach drifting towards the west takes place on the seaward facing sides. The ridges mapped for the first time in Holkham Bay and immediately east of Wells Harbour Channel are of the same nature.

Re-mapping of Scolt Head Island, Lodge Marsh Island, and Blakeney Point has but emphasised the continuity of change resulting from wave action working on them. The break-through of the sea-wall at Titchwell, or even the far less

important one at Norton Hills on Scolt, are more sensational, and if conditions favour their extension may become of major significance. It is, however, the slow continuous changes resulting in the building of ridges or in the gradual cutting back of dunes or cliffs, that should be watched. Landowners are well aware of the danger at Gore Point, but the threat there, from the purely natural point of view, is but complementary to the growth of the spit enclosing Holme Marsh and the ridge fronting the Holme—Thornham dunes. The paring away, gradual though it may be, of the big Hut Dunes at Scolt Head is serious. On the other hand, in Holkham Bay, the dunes, partly as a result of natural causes, and partly as a result of artificial aids, are prograding. The same is true on a very small scale at the apex of Lodge Marsh Island. It is not easy to give reasons why these places are gaining whilst others are losing; the most important point is first to establish the facts, and secondly to map them and, by comparison of air photographs and frequent surveys, study the annual or even shorter term changes which are taking place. Progradation in any place may well give place to erosion, or vice-versa. A careful comparison of the six-inch map, Peel's map of 1932, and our mapping this July of Brancaster Golf Links, demonstrates this point.

BIBLIOGRAPHY

F. W. Oliver, Blakeney Point Publications, No. 4.

F. W. Oliver and E. J. Salisbury, Blakeney Point Publications, No. 7.

A. E. Carey and F. W. Oliver, Tidal Lands, Chapter 12, 1918.

B. Cozens-Hardy, Cley-next-the-Sea and its Marshes, *Trans. Norf. & Norwich Nat. Soc.*, 12, 1924–29, 354.

Second Report of the Commissioners appointed to enquire into Tidal Harbours, 1946 (Wells and Holkham and Blakeney).

J. A. Steers (Editor), Scolt Head Island, 1934. Some Notes on the North Norfolk Coast, *Geogr. Journ.*, 87, 1936, 35.

Annual Reports in *Trans. Norf. & Norwich Nat. Soc.*

A. S. Marsh, The Maritime Ecology of Holme-next-the-Sea, *Journ. Ecology*, 3, 1915, 65.

J. A. Steers, Twelve Years' Measurement of Accretion on Norfolk Salt Marshes, *Geol. Mag.*, 85, 1948, 163.

V

THE MATING HABITS OF ROE DEER.

By Anthony Buxton.

Since my last article on this subject was published in these Transactions (Vol. 17, 55), two seasons have passed, and I have seen at Ardtornish in Morvern, Argyll, a good deal more of roe during their rutting season, which is in the last week of July and the first fortnight of August. It may be worth while to summarize the results.

In 1950, I found four sets of rings in three quite different types of country : two of these were on rushy flats in the same places as in 1949, the other two were on ground, where I had always seen roe tracks in previous years, but had not actually found the rings. One of the two sets of rings in places occupied before, was not completed for reasons unknown. These rings were begun by a doe, who came to my German-made roe call as I sat in a hide by the rings ; this call is supposed to imitate the squeak made by a doe when she wants a buck to come to her. She arrived at a fast trot accompanied by her fawn, then about two months' old, no doubt intending to kick out that other interfering female from her rings. I proved in 1950 that although the fawns never accompany their mother when she goes to the rings with her buck, they may be allowed to do so both before and after the honeymoon period, which only lasts 3 or 4 days.

I was lucky in finding one pair of roe which could be reached in a very short time by car from the house where I was living. They had made a hole through a wire fence into an oatfield with a mound in it. Headquarters was the mound, and I found a ring in thin oats quite near the mound. For obvious reasons I did not walk about in the oats to find other rings, particularly when the factor had kindly agreed to leave open the hole in the fence.

I learnt a lot from these roe and had the greatest fun stalking them through a wood that bordered the field on one side, and made good shade through which to approach and set up a camera. When first seen the pair consisted of a full grown

doe and a very young buck. At the critical moment a much bigger buck kicked out this young gentleman and took over the doe, but the younger animal remained in the neighbourhood, never I think being allowed again through the hole in the fence.

On August 8th this pair arrived at 8.20 p.m. at a fast trot, went through the hole in the fence on to the mound, where the buck immediately served the doe three times in about three minutes. I was all ready for them, knew the range, and had just taken a light reading, so that despite the late hour the film is quite clear. I failed to see the other two pairs of roe at their rings.

In three seasons I have now seen a buck serve a doe on 22 occasions, invariably between 6.30 p.m. and dark, never in the morning. The dates of mating and of pairs of roe actually at rings are in every single case between August 1st and August 14th. The latest date at which I have seen a buck and doe together is August 16th. I have not yet seen a buck with a doe in July, but the stalker, John Anderson has; the buck, however, did not seem to be taking much interest in the doe. This absolute punctuality of dates all over Europe is most remarkable.

I was unlucky in 1950 with another pair which made rings in a flat at the foot of a bank and between it and the river Aline, on ground absolutely covered with very thick low vegetation. These were the clearest rings I ever saw; in fact the ground looked as if a miniature circus had been taking place on it. Rings are well or badly marked entirely according to vegetation, e.g. in thin oats they might easily be missed: in thick, low vegetation they are obvious. Both at these rings and at those in the oatfield the main food of the roe was clearly meadow sweet. The tops of the plants had been nipped off in all directions.

I made careful plant collections at the time from every one of the three sets of rings used in 1950, picking only from within a roe's reach of a roe's fresh tracks. The collections were sent to Mr. E. A. Ellis, and the results of his investigations strike me as stronger evidence than that obtained in 1949, which led me to suspect that Ergot is the draw to the rings, and the element which somehow dates the rut. In 1950 one or

more of the following plants were found to be infected with ergot at each of these three sets of rings :—Sweet Vernal Grass, Fog Grass, False Oat, Tufted Hair Grass, Purple Moor Grass. Let's leave it at that. More proof is needed, but it looks a bit fishy.

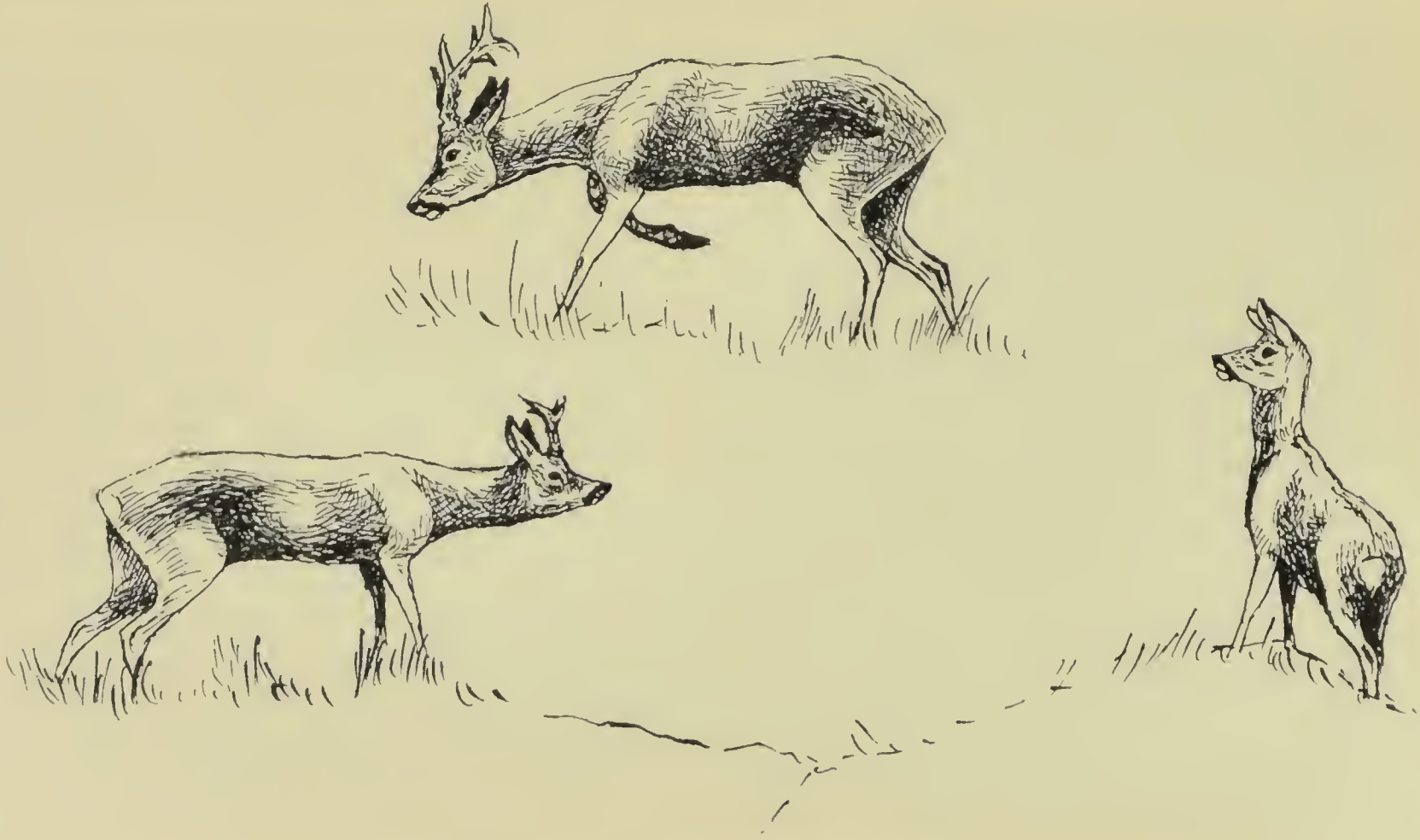
Purple Moor grass, which covers thousands and thousands of acres at Ardtornish, was heavily infected in 1949, very little infected in 1950, and heavily infected again in 1951, but the results of 1950 show that there are other grasses liable to infection by ergot in Morvern, and no doubt at other haunts of roe.

In 1951, although I found no rings, partly owing I think to very heavy grazing by cattle and sheep on ground where there had been rings in 1950, I saw, thanks to two pairs of roe, the early stages of the honeymoon business, and very amusing they are. A big buck and a doe were watched on the evenings of August 5th and 6th, when they were feeding quietly, but when the doe reached the edge of a birch wood the buck, who had just lain down, got up, walked fast up to the doe, and clearly took great care never to let her out of his sight. On the next evening, August 7th, when I expected to see and possibly to photograph this pair at a most interesting moment, my chances were spoilt by some red deer hinds, who galloped past the roe and disturbed them.

The roe were worried, but not sufficiently to prevent the buck running up to the doe and serving her within 5 yards of one of my hides (of course, unoccupied). The doe then trotted across my front towards a hind, who was barking, presumably to find out what the trouble was about. The buck followed reluctantly and stopped a hundred yards in front of me, when he pawed the ground like a bull.

This pawing is no doubt an action of defiance, but whether its purpose in this instance was to drive off the red hind or to fetch his doe back to him I do not know. If the latter he failed, for they both disappeared into a wood. I have seen hundreds of pawing marks, which are the best indication I know of the presence in any given area of a roe buck in the rutting season, but I had never seen one actually pawing before. In addition to pawing, I found this year clear proof that a buck selects

ROE BUCK PAWING



Both: "Now, I wonder whether you will do."

rather but not very rotten tree stumps, pretends that they are rival bucks and gives them absolute hell with his horns. Since I found no rings in 1951 I made no plant collections, for plant collections made vaguely anywhere would prove nothing.

Another pair consisting of a big doe and a small buck were seen crossing a grassy flat between birch woods at 7.45 p.m. on August 12th. They fed a few yards apart and every now and then both would raise their heads and stare intently at each other as though each were saying, "Now, I wonder whether you will do." I also saw the buck following the doe, nose on her stern, at a fast walk, and serving her three times. Then they broke into a furious gallop in and out, round about, uphill and downhill and into a wood—the doe not I think galloping quite as fast as she might have done. I laid in wait for this pair the next evening, and when the light was going saw the doe through trees on the edge of bracken. I could not see the buck, but as I saw him with the doe near this spot two days later it is probable that he was really there all the time but invisible, as he might well have been for the light was bad and the bracken was high.

In September after a great stalk I let off thirty feet of film on this doe, at a range of 30 yards, and for the first twenty, probably owing to the movement of her feet in the grass, she heard nothing. Then suddenly that mechanical reeling reached her ears, and she sprang to attention looking as only a roe can—saucy, inquisitive, utterly lovely. It was a great moment and when she had bounded away like an india rubber ball I took my hat off and said Thank you, and au revoir. I am always terrified that owing to some idiocy on my part the film will not come out, but it has.

Last, but not least, a tame roe doe of my acquaintance, born on May 30th, 1949, has, as I expected she would, been behaving in a most peculiar manner this year. Her mistress tells me that on August 3rd, 1951, this doe became very restless, running up and down her enclosure and making little jumps. On August 8th two sons of a friend of the roe's mistress came to see the doe, and while they stood outside the run the doe dashed up and down squeaking all the time. She had never been heard to squeak before. She continued being restless

occasionally in the mornings, especially every fourth day, but had quietened down by August 16th.

In early October a Forester came to see the roe and while he stood outside her run she squeaked all the time he was there. Some days later a Veterinary Surgeon entered the roe's enclosure and she ran round him squeaking all the time. She has never squeaked when the gardener approaches her or when a carpenter has worked on her shed. She has never squeaked at a woman. I would recall that pairs of roe have been seen each year by the stalker at Ardtornish revisiting in the first fortnight of October the scene of their honeymoon in the first fortnight of August, but merely lying and feeding quietly, and showing no excitement.

Now what does all this mean ? If ever there was a Fairy story to unravel, here it is.

VI.

MISCELLANEOUS OBSERVATIONS.

Compiled by E. A. Ellis.

Herb Paris. *Paris quadrifolia* L. was found growing in great abundance in an alder carr at Hindolveston, in May, 1951

(T. W. Irvine).

Lettuce Rust. Inoculation experiments carried out with *Puccinia opizii* Bubák, the clustercup rust of cultivated lettuces which appeared in Norfolk during 1950, have shown that this fungus produces uredo- and teleuto-spores on the tussock sedges, *Carex paniculata* L. and *C. appropinquata* Schumacher at Wheatfen Broad, Surlingham. Clustercups were produced on the wild lettuce, *Lactuca virosa* L. in addition to several varieties of garden lettuce, *L. sativa* L.

(E. A. Ellis).

Banana Spider. A female of the large poisonous spider *Ctenus ferus* (Perty) was found with bananas in a Norwich warehouse in May, 1951. It produced an egg-cocoon in July and the young emerged in great numbers early in September, after which they were deposited at the London Zoo. This species has been recorded as native in Brazil and Paraguay.

(R. M. Barnes).

Flying Squids. A specimen of *Todarodes sagittatus* (Lam.) nearly three feet long was picked up from the surf on Weybourne beach by Mr. H. Batley on January 14th, 1951 and nine further examples were found between Weybourne and Cley on 26th February by Mr. R. P. Bagnall-Oakley. Large quantities of cuttle-bones were washed up on the Norfolk coast between Mundesley and Gt. Yarmouth at the beginning of January.

Scarce Water-Measurer. *Hydrometra gracilenta* Horvath was rediscovered at Barton Broad on 29th April, 1951, when many specimens of both sexes were found sheltering under tussocks of the sedge *Carex paniculata* L. in a swamp. No other British locality is known for this insect.

(E. A. Ellis).

Salt-Marsh Horse-Fly. During the second week of August, 1951, the large horse-fly *Tabanus nigrifacies* (Gobert) was common at Scolt Head Island. The females attacked visitors incessantly during sunny weather and the males were seen to visit flowers of common sea lavender on the flats. This species had not been recorded previously from Norfolk and it may be a recent colonist.

(E. A. Ellis).

Note by Editor. Members are invited to contribute short notes on the Flora and Fauna of Norfolk for the next issue of *Transactions* as it is hoped to devote more space to this feature than is possible for reasons of economy this year.

MEMBERSHIP.

Candidates for ordinary membership may be nominated and elected at any meeting of the Society ; three dissentient votes shall exclude a candidate.

The annual subscription is fifteen shillings, payable on election or at the beginning of each financial year (April 1st) to the Hon. Treasurer, D. A. P. Gould, 8, Upper King Street, Norwich, who will supply a banker's order form for this purpose on request. Members may instead pay a life composition fee of £12.

Every member is entitled to receive one copy of the *Transactions* as published annually ; to attend the meetings and excursions and to make use of the Society's library. Members may bring friends to meetings.

Enquiries should be addressed to the Hon. Secretary, Miss H. N. Benn, Castle Museum, Norwich, to whom also applications should be made for back numbers of the *Transactions*.

MATERIAL FOR PUBLICATION.

The Hon. Editor will be glad to consider papers, preferably on Norfolk natural history, for the *Transactions*. These should aim at clarity of expression and should be typewritten. Such contributions should reach the editor by the end of September. The cost of a reasonable number of illustrations will be borne by the Society, but where great expense is likely to be incurred it is hoped that authors will endeavour to share the cost, by obtaining grants or otherwise. Authors receive 25 off-prints of their papers free and further copies may be ordered in advance either through the Hon. Secretary or the Soman-Wherry Press Ltd., Heigham Street, Norwich, from whom an estimate of the cost can be obtained.

CHANGE OF ADDRESS.

Prompt notification of members' changes of address will greatly facilitate the work of the officers of the Society.

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I

PRESIDENT'S ADDRESS

*Delivered by Dr. J. M. Lambert, M.A., F.L.S., to members of the Norfolk and Norwich Naturalists' Society at the Castle Museum, Norwich on 19th April, 1952, and partly amended before publication.**

THE PAST, PRESENT AND FUTURE OF THE NORFOLK BROADS

Introduction

I THINK we may safely say, with legitimate local pride, that the Norfolk Broads, as they exist to-day, are unique. From the geographical standpoint, there is little in our country to compare in detail with the complicated pattern of winding rivers and closely associated stretches of open water found in our wide, alluviated Norfolk valleys. From the standpoint of plant and animal ecology and natural history, the great areas of natural and semi-natural fenland round the broads are only imperfectly matched by certain small isolated fens, often existing as relicts and much modified by drainage, of which Wicken Fen in Cambridgeshire is probably the best known (63, etc.).

It is all the more surprising, therefore, that so little intensive scientific investigation has yet been carried out within our Broadland heritage. Though many men and women—past and present, local and otherwise—must have had, or have, an intimate knowledge of the region, the scanty published data which are available for reference are quite disproportionate to the value of the area as material for sustained historical,

*NOTE: The emendations have been made necessary by the establishment of significant new data, calling for a major reconsideration of the whole problem of the origin of the broads, between the time at which the address was originally delivered and the submission of the typescript for publication. With the Editor's permission, the section on the origin of the broads has been largely re-written, and minor alterations have also been made elsewhere in conformity with this.

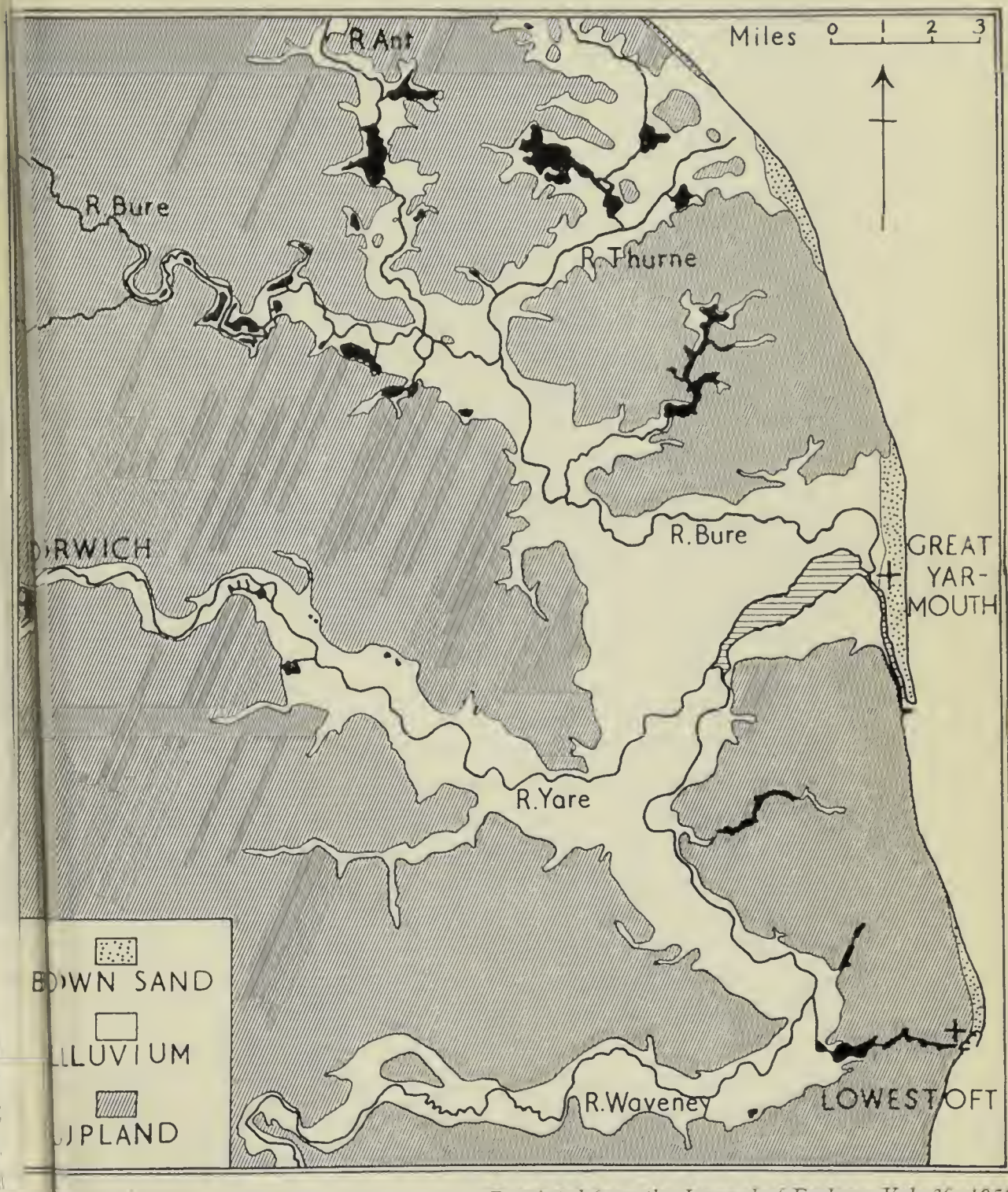
J. M. Lambert, 5th December, 1952.

geographical and biological research. An excellent start was made at the beginning of the century by workers at the old Sutton Broad laboratory, with their emphasis on the bionomical approach and their attempt at integration of physical and biological data (2—4, 28—34, 54, 55, 61, etc.) ; contemporary with some of these investigations, but largely independent of them, we have the classic pioneer work of Miss Marietta Pallis (59), the first to survey the vegetation of the region as a whole on broad ecological lines ; and now, after a lapse of several years while work in Norfolk was concentrated in other districts —particularly the North Norfolk coast—the Wheatfen area (12, etc.) is rapidly becoming the centre of a revived interest in Broadland studies, thanks to the active encouragement of Mr. E. A. Ellis. Another landmark we must not omit to mention is the post-war production of the Broads Conference Report (56), though the purpose of this lay more in the bringing together of current ideas and formulation of problems than in the establishment of new scientific facts.

Despite the value of these and other contributions, however, we find we still possess remarkably little detailed information as to the real nature of the phenomena and events which have interacted to produce the present pattern of the Broadland area. I must ask you therefore to interpret the title of my address— " The past, present and future of the Norfolk Broads "—not as a rounded statement of accepted fact, but rather as an attempt to summarise our existing very incomplete knowledge of the past and present condition of the broads and surrounding fenland, and—very tentatively—to give some pointer to the possible future evolution and development of the area in the light of such evidence as we possess.

The General Features of the Region

The Norfolk Broads are all situated in close relationship with one or other of the three chief East Norfolk rivers—the Bure, the Yare and the Waveney—or their tributaries (Fig. 1) ; the Waveney broads actually lie just over the Suffolk border, but are nevertheless an integral part of the system centred in Norfolk and will therefore be included under the general heading. The Broadland rivers are alkaline owing to the nature of their drainage basins, and are strongly tidal in their



Reprinted from the Journal of Ecology, Vol. 36, 1951

FIG. 1. GENERAL MAP OF THE REGION OF THE BROADS

lower reaches by virtue of the small gradient of their courses. The daily rise and fall is much greater in the Yare and Waveney, debouching on Breydon Water in direct line with the tidal current, than in the corresponding reaches of the Bure, whose mouth is by-passed by the main flow of water. The salinity effects of the tides do not, however, normally extend upstream as far as the broads themselves (36), though those in the Horsey—Hickling area are slightly brackish through the effect of an independent underground salt-water table from the sea (58).

As a whole, the broads have generally been considered to fall into two main types, conveniently known as "side-valley" and "by-passed" broads respectively. The former occupy subsidiary valleys, and lie in the direct line of the main drainage of the small tributary streams; the South Walsham Broads and the Ormesby—Rollesby—Filby series form good examples of this type. The by-passed broads, on the other hand, lie in the flood-plains of the chief rivers themselves; they tend to lie within the curves of meander bends on either side of the main river channels, from which they are separated by strips of fenland. The characteristic position of this type of broad is best seen in the very comparable middle reaches of the Bure and Yare valleys, illustrated in Figs. 2 and 3.

The map of the middle Bure valley (Fig. 2) shows a gradual widening of the flood-plain downstream, with the river swinging from side to side. Roughly east of Antmouth and the South Walsham Fleet Dyke, the alluvium is embanked and drained, and used as grazing levels; further upstream lies the undrained fenland bearing natural and semi-natural vegetation. Apart from the South Walsham series, the broads shown in the map are all of the by-passed type. They lie progressively further from the river as the valley widens seawards. The most downstream broad of this series—Upton Broad—is completely isolated from the river by intervening pasture; the other broads are connected with the general river system by a series of artificial dykes or cuts, some of which have become overgrown within comparatively recent times.

The corresponding reaches of the Yare (Fig. 3) show a similar seaward widening of the valley, and a comparable division into drained and undrained regions, though the latter is significantly

less extensive than that of the Bure. There is here no well-marked existing example of a side-valley broad ; there is some justification, however, to place the extinct Carleton Broad mainly within this category if we assume artificial diversion of the supplying tributary stream (49). The pattern of the other broads in relation to the river is essentially similar to that of the by-passed broads of the Bure, though those of the Yare are less numerous. The three most upstream Yare broads—Surlingham, Strumpshaw and Rockland—are connected with the river by artificial dykes like the great majority of the Bure broads. Buckenham and Hassingham Broads, however, correspond more to Upton Broad in that they are separated from the river by drained grazing land ; the dyke previously linking them to the river is now closed by a sluice, rendering them, like Upton, land-locked and non-tidal.

Still further southward, in the Waveney valley, the alluvial flats are almost entirely drained, and the number of by-passed broads is reduced to the two small isolated Barnby Broads, one of which is now grown over and extinct. The other Waveney broads—Fritton and Flixton Decoys, and Oulton Broad—are all of the side-valley type.

The distribution of broads in the two chief secondary valleys —the Ant and Thurne—shows certain variations from this general pattern, though basic similarities still are seen. In the Ant valley, Dilham and Sutton (Stalham) Broads are by-passed by the river, with Sutton occupying a deep forked indentation of the upland making it almost side-valley in position ; more typical side-valley broads, further removed from the river, are seen in Crome's and Alderfen Broads. But the general plan is modified in the region of Barton Broad by past artificial diversion of the main river to run through the broad itself ; the former river bed, lying to the east of the broad and completely overgrown, has been identified by borings (38), and its presence indicates the original lateral position of Barton Broad to the Ant. In the Thurne valley, by-passed and side-valley broads are represented by Martham (Somerton) Broad and Womack Water respectively : but the Hickling—Heigham —Horsey pattern has been complicated by changes in drainage relationships and the making of artificial cuts.

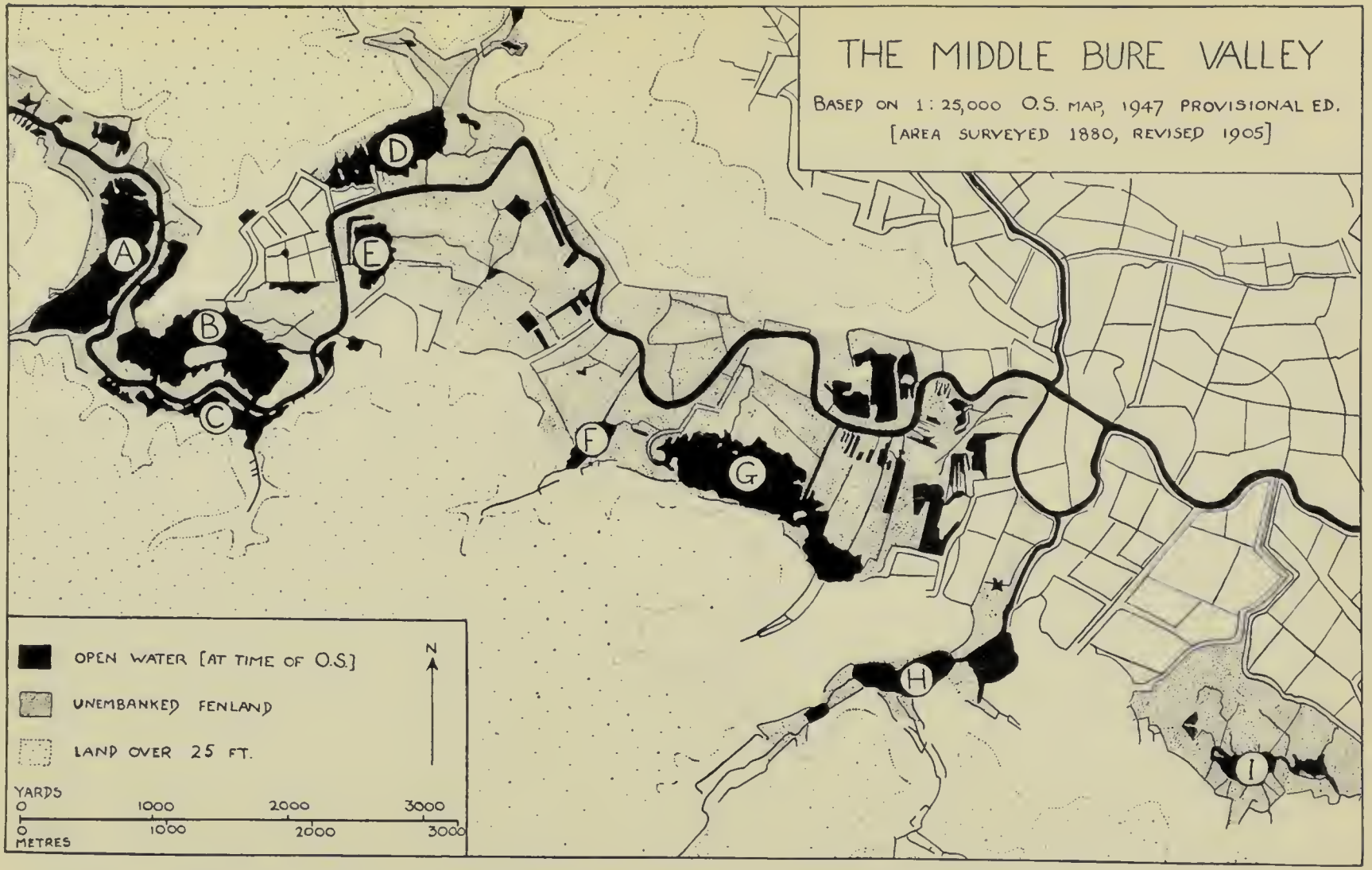


FIG. 2. SKETCH MAP OF THE MIDDLE BURE VALLEY TO SHOW THE POSITION OF THE ASSOCIATED BROADS IN RELATION TO THE RIVER.

A—Wroxham Broad; B—Hoveton Great Broad; C—Salhouse Broad; D—Hoveton Little Broad (Black Horse Broad); E—Decoy Broad; F—Cockshoot Broad; G—Ranworth Broad; H—South Walsham Broad; I—Upton Broad.

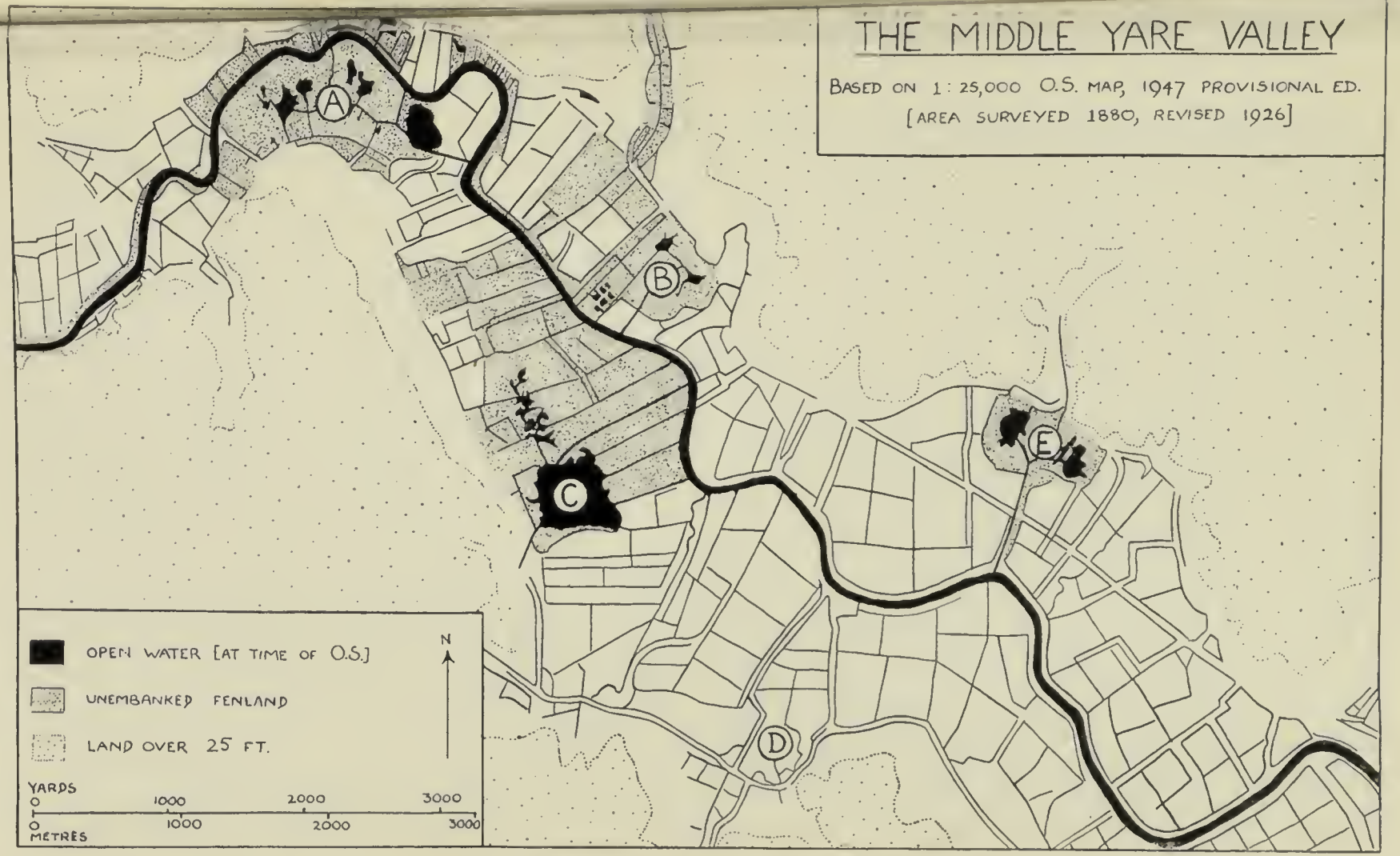


FIG. 3. SKETCH MAP OF THE MIDDLE YARE VALLEY TO SHOW THE POSITION OF THE ASSOCIATED BROADS IN RELATION TO THE RIVER.

A—Surlingham Broad; B—Strumpshaw Broad; C—Rockland Broad; D—Carleton Broad (now extinct); E—Buckenham and Hassingham Broads.

The Origin of the Broads

Despite the diversities which have been mentioned, the basic uniformity of pattern shown by the river valleys strongly suggests some underlying geographical relationship between the rivers and their associated broads. In fact, the broads themselves have hitherto been very generally regarded as natural geographical phenomena, and frequent attempts have been made to explain how they were formed. The origin of the broads was a popular subject of predominantly theoretical argument throughout the 19th century, culminating in a paper by Professor J. W. Gregory in 1892 (26). Some of these early theories have been summarised by Mr. J. E. Sainty in a recent paper in the Transactions (60), and I need not repeat them here. In the absence of further concrete evidence, Gregory's views persisted as the standard account of the formation of the broads until 1938, when the problem was revived by Dr. H. Godwin in relation to his findings in the neighbouring Fenland (22, 24). This led to the re-examination of the whole question during the last decade by Mr. J. N. Jennings (37, 38). By means of boring through the alluvium of the Ant and middle Bure valleys, the latter provided definite stratigraphical data to offset or supplement the earlier theoretical arguments, and put the whole problem on a sound factual basis. The stratigraphical work has subsequently been extended in more detail to the middle Yare by the present writer (49), and a general picture of the nature of the broads now seems to be emerging (41).

The boring so far carried out in the Ant, the Bure and the Yare has shown that the position of the broads in general is clearly related to the disposition of the various alluvial deposits laid down during the natural physiographical evolution of the valleys in Postglacial times (Fig. 4). The later phases of this evolution, which chiefly concern us here, were dominated by a geologically very recent marine invasion of our present Broadland region, during which the seaward parts of the valleys were drowned and converted into a branching estuarine system. The encroaching salt or brackish water overwhelmed the vegetation which had previously occupied the valley floors, and which had already formed a considerable depth of brushwood or fen peat. Mineral sediments were carried upstream by this flooding

tidal water and deposited over these peats. In at least the middle reaches of the valleys, the sediments are represented by a wedge of soft, blue-grey clay, following the meanders of the tidal channels closely ; the clay horizon occupies the whole width of the valleys downstream, but gradually peters out upstream. Between the lateral limits of this tapering tongue of clay and the upland valley margins, a zone of continued organic accumulation—chiefly of loose, uncompacted fen and reed-swamp peats, with small, scattered pockets of organic mud—has been found : and indeed, the shallow flanges of the clay itself are impregnated with vertical haulms of reed preserved in position of growth. This gives us evidence that the middle reaches of the valleys were not completely flooded even at the time of maximum marine transgression, though the inland tidal margins were bounded by fen and reedswamp plants, with interspersed, very shallow, reedy pools, reflecting the wetter conditions existing throughout these valleys at that time.

The dating of the estuarine transgression responsible for the deposition of the clay is still in process of investigation by the technique of pollen analysis.* A preliminary report by Mr. Jennings (38), based on pollen diagrams prepared by Dr. Godwin from the Ant valley, estimates that this incursion probably began during either Early Iron Age or Roman times ; its effects must certainly have ceased before the end of the Middle Ages, and probably many centuries earlier. This dating has subsequently been confirmed by a pollen series from the Ranworth region of the Bure (J. N. Jennings, *in litt.*, 1952). During the recession of the sea which followed the invasion, the rivers became progressively less salt and more and more confined to narrow tidal channels, while the retreat of marine influence

*Note : Pollen analysis consists of the isolation, identification and numerical assessment of the different types of pollen grains found trapped and preserved in peats, muds and other deposits. The pollen content of vertical series of samples from such deposits reflects the changing composition of the surrounding vegetation as the various layers were progressively laid down. If the percentages of the different types of pollen in the samples are plotted as continuous curves to show the increase, decrease, or first appearance of different species from the bottom of the deposit upwards, it is often possible, by correlation with long-term climatic changes since the Ice Age and with other data, to assign each layer approximately to the phase in history in which it was formed (21, etc.).

allowed fresh vegetation to spread over the area of the deposited clay. This was accompanied by the elimination of the small, shallow, muddy pools beyond the limits of the clay, and the replacement of reedswamp by fen, and later in parts by carr. Despite this inauguration of slightly less wet conditions in the valleys, these nevertheless appear to have been favourable for the continued accumulation of peat after the estuarine incursion up to the present day ; three or four feet of these recent peats have been found above the upper surface of the clay in the undrained and unexploited parts of the valleys, while the loose, wet, reedswamp peats and shallow muds occurring patchily lateral to the clay are likewise buried beneath a comparable depth of compact fen and brushwood peat.

Although there are certain significant differences in detail, especially in the nature of the lower peats and in the relative extent of the clay, the series of deposits giving the story outlined above has been found to be essentially similar in the Ant, the Bure and the Yare ; it should perhaps be noted here that these findings were partly foreshadowed in a map of the middle Yare published by Miss Pallis in 1911 (59), though she did not indicate the vertical relationships of the surface deposits which she showed, nor discuss fully their significance. The general stratigraphy of the Thurne and Waveney has not yet been investigated in any detail, but it is perhaps worth mentioning in the present connection that preliminary bores made during 1951–52 (49) have shown the presence in the Thurne valley of a similar vertical sequence of deposits, with a horizon of clay overlying brushwood and fen peat, beneath Whiteslea Lodge at Hickling and on the south margin of Horsey Mere near the old Hundred Stream ; the clay has also been identified in the vicinity of the Barnby Broads in the Waveney valley, where it was found to overlie compacted organic mud instead of peat in the single isolated bore which has so far been put down. The general story of marine invasion and retreat therefore appears to hold for all the main Broadland valleys.

It is now time to turn to the broads themselves and consider their place in the general pattern before us, a pattern mainly of interdigitating peat and clay. Again, it is chiefly stratigraphical evidence which has indicated the relationship of the broads to the natural valley deposits described above, and has begun to

reveal their story. The boring in the Ant, the Bure and the Yare has shown that the typical by-passed broads are restricted to those parts of the valleys where the clay deposits only extend partway across them; they occupy individual peat-lined basins, of definitely limited extent, lying between the flanges of the clay wedge and the upland valley margin (Fig. 4). The side-valley broads, though not yet worked in detail, are estimated likewise to occur beyond the limits of the clay, which does not appear to extend far up the smaller tributary valleys.

The actual basins of most of the investigated broads, containing thick, uncompacted muds, have been found to extend well down into the peat below the level of the horizon marking the estuarine transgression. In the Yare valley, close spacing of bores has revealed that the basins have virtually vertical sides, and that steep-sided peninsulas, islands, and ridges of peat are of frequent occurrence within them (Fig. 5). Comparable vertical edges have also been identified in broads of the Bure and the Ant, and this, together with other supporting evidence which cannot be given here,* leads to the conclusion that at least the majority of the broads have an artificial origin. Their basins have been formed of undoubted excavations, presumably representing hollows left by deep extraction of peat in historical times, and subsequently flooded after abandonment of the individual workings.† The broads thus formed must at first have been sheets of relatively deep water, bounded by sharp margins of undisturbed deposits; but progressive shallowing of the water by rapid accumulation of organic and calcareous muds comprised of the remains of aquatic plants and animals, and overgrowth of the margins by encroaching vegetation, have combined to produce the generally more natural appearance of the broads as we know them to-day.

It has already been indicated, from surface features alone, that the broads tend to be situated in definite relationship to

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*NOTE: A full presentation of the evidence, which is not yet published, will be made elsewhere later.

†NOTE: It seems probable that the initial flooding of the excavations took place mainly by seepage water, and that the artificial cuts connecting the broads to the rivers were made later to open up the sheets of water for trading and other purposes.

EXPLANATION OF FIG. 4.

The generalized sections shown in the folding diagram opposite are constructed from a series of lines of bores made across the middle Bure valley by Mr. J. N. Jennings : for the sake of clarity and space, the vertical scale is greatly exaggerated in relation to the horizontal.

Sections A, B and C were made in the region of the undrained fenland, and pass through the basins of certain of the broads ; Section D traverses the drained grazing levels near the confluence of the Ant and Bure.

The four sections together serve to illustrate the general sequence of deposits in the middle region of the valley. The main alluvial fill is formed by a mass of predominantly brushwood peat, laid down by the fenwoods formerly occupying the valley floor. The clay deposited by the marine transgression which destroyed these woods forms a diminishing wedge, occupying the whole width of the valley in Section D, but progressively reduced upstream in Sections C, B and A. Section C also shows a smaller clay flange below the main clay wedge ; this, together with the muds occupying a comparable position in Sections B and A, represents the expression of an earlier, less extensive, estuarine transgression than that responsible for the prominent upper clay horizon.

The upper clay is overlain in Sections A, B and C by recent fen peat, mainly of reed. In Section D, this upper peat has disappeared as a result of wastage through drainage, and the present surface of the alluvium here lies below that of the embanked river.

The position of the deep clay channel forming the central portion of the main clay wedge corresponds fairly closely with that of the present tidal channel, and shows some asymmetry—especially marked in Section C—in relation to the meanders of the river.

The basins of the broads are seen to lie mainly between the edge of the upper clay flange and the upland valley margin ; in Section B, where the section line runs parallel with, and close to, a reach of the river in the region of Decoy Broad, part of the clay wedge appears on both sides of the broad along the section line.

In the four given sections of the Bure valley, the bores are too widely spaced to show the exact shape of the basins of the broads : pending further evidence, these are therefore drawn in conformity with the general picture established for the broads of the Yare valley (see Fig. 5) and with some evidence available for a few other parts of the Bure.

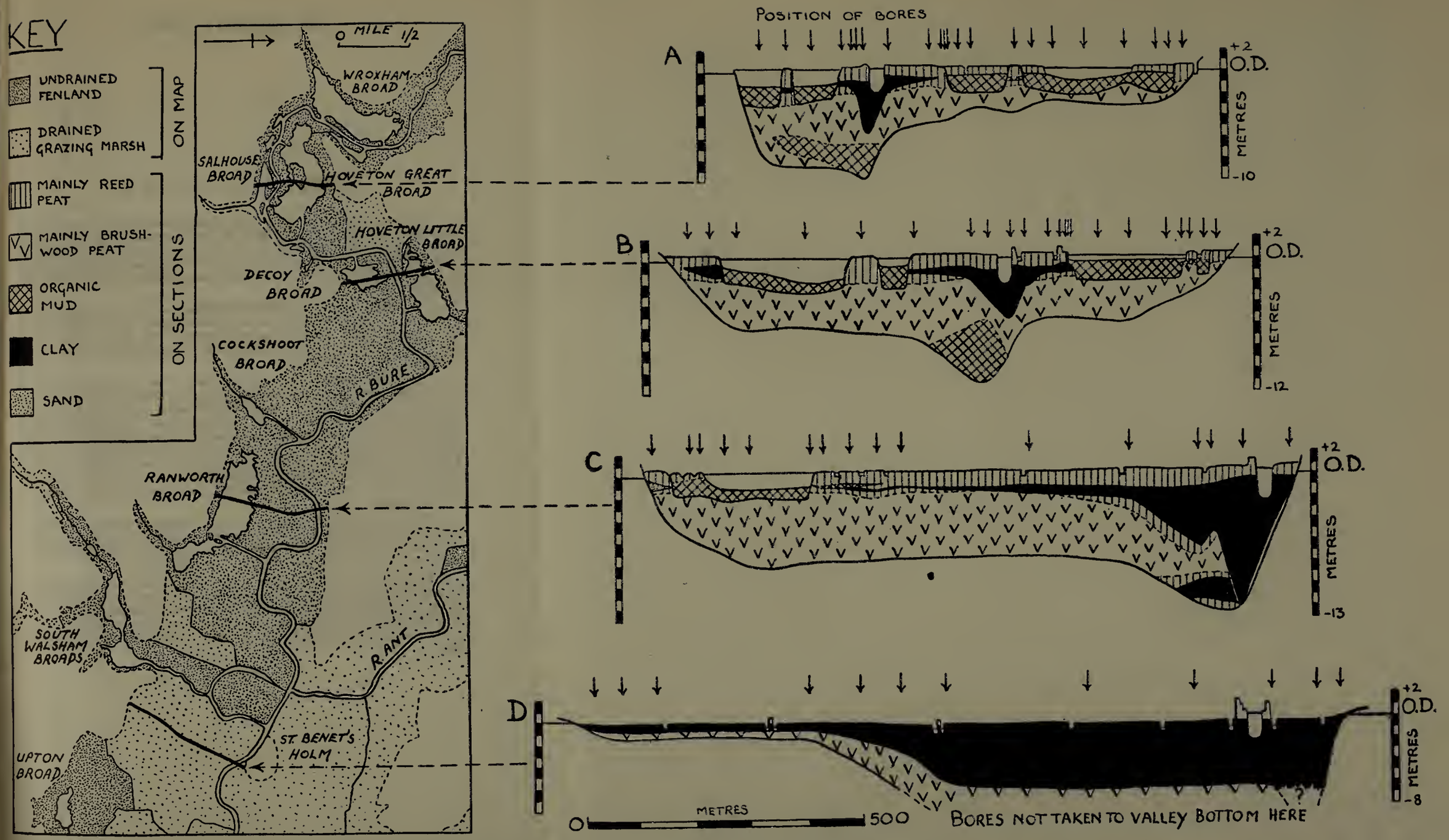

FIG. 4. GENERALISED SECTIONS IN THE ALLUVIUM OF THE MIDDLE BURE VALLEY.

(VERTICAL EXAGGERATION X 20).

(Re-drawn and slightly modified from a figure published in *Journ. Ecol.*, Vol. 36, 1951).

EXPLANATION OF FIG. 5.

The part-sections from the Yare valley shown in the figure opposite are constructed from lines of bores in a similar manner to the complete Bure valley sections in Fig. 4, though the overall scale is different. The first two of the present series are half-sections, running from the valley margin to the river ; the third part-section ends some distance from the river.

The Surlingham and Rockland sections show the relationships of their respective basins to the natural stratigraphy of the valley : while the Crake's Marsh section, running between the two broads, shows undisturbed natural deposits except for a small surface peat cutting near the landward margin.

From all three sections, it can be seen that the general sequence of alluvial deposits is essentially similar to that of the comparable region of the Bure valley, though there is some replacement of brushwood by mixed fen peat in the Rockland area. In the Surlingham section, the clay flange has obviously been cut through by the excavation forming the basin of the broad ; in the Crake's Marsh section, the clay peters out naturally in the landward direction, and a shallow pocket of mud, immersed in reedswamp and fen peat, occurs in lateral conformity to it ; and in the Rockland section, the clay flange is again attenuated by the broad.

The basins of both Surlingham and Rockland Broads reach down into the peat well below the level of the estuarine horizon. The close-set bores reveal that both basins are steep-sided, and that baulks of solid peat, or peat and clay, project from their floors.

Both broads are filled with a considerable depth of organic mud. In the Surlingham section, the muds have been entirely overgrown by recent vegetation in the region of the broad where the section was made. The Rockland section has been made across an area where much open water still remains, though there is some overgrowth on the landward side.

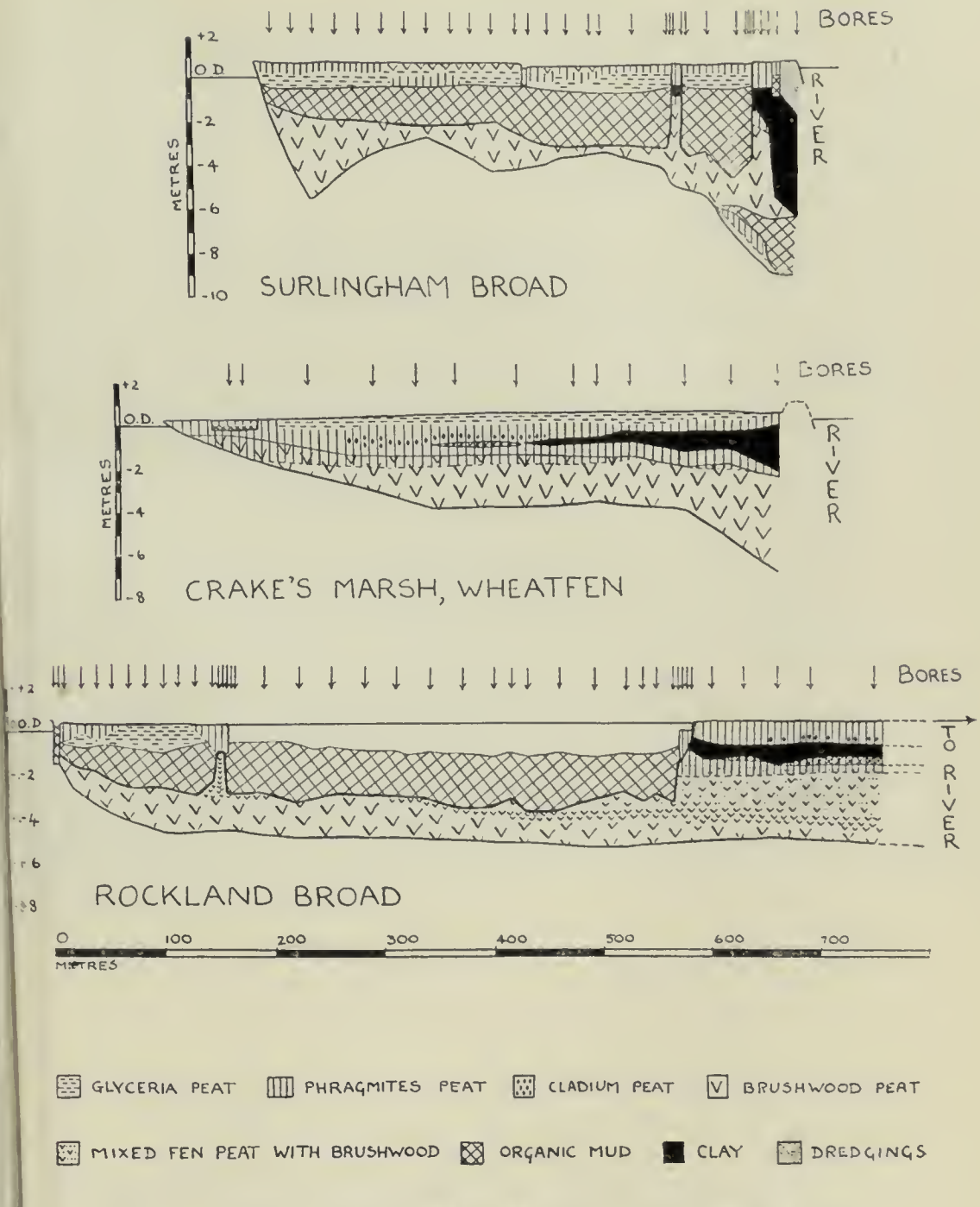

FIG. 5. PART-SECTIONS IN THE ALLUVIUM OF THE MIDDLE YARE VALLEY, IN THE SURLINGHAM—ROCKLAND REGION.

(VERTICAL EXAGGERATION X 20).

the river channels, and the explanation of this distribution may now readily be seen. The most profitable areas for deep peat excavation were obviously those where there had been continued accumulation of organic material, and where the valuable peat deposits were not interrupted by a horizon of impure, reed-impregnated clay. The sites of human activity were thus largely governed by the lateral disposition of peat and clay and concentrated beyond the limits of the latter : the position of the resultant stretches of open water forming the broads therefore inevitably reflects the underlying natural physiographical pattern, related to the sinuous courses of the rivers.

The outline given above appears to be of general application for the origin of the typical by-passed broads as a whole, though reservations, through insufficient data, must still be made in respect of the less numerous side-valley broads. In a slightly different category lie the stretches of Hickling Broad and Horsey Mere. In the former, preliminary observations suggest that there is a continuous hard bottom, at a depth of only about three to four feet, over much of its area ; this bottom appears to be mainly composed of compact, fibrous peat, or peat and clay, though it is gravelly in parts. Horsey Mere likewise appears to have a fairly uniform hard bottom, partly of peat, and partly of estuarine clay. These broads are obviously somewhat different in character from the deeper broads already described ; they appear to have been formed by much shallower excavations which only tapped the superficial deposits above the estuarine horizon, with the cutting reaching the original gravelly valley bottom where the latter approaches the surface near the upland. Shallow, hard-bottomed areas also occur in parts of Barton Broad, and it should be noted that the presence in the middle of the broad of a shallowly-submerged ridge of peat along the Barton—Irstead boundary, together with the occurrence of clearly-defined solid edges to parts of the broad itself, led to an early suggestion of artificiality here (64).

The dating of the excavations forming the broads has yet to be pursued, and it is here that such documentary evidence as may be available will have to be called in to play its part. From the stratigraphical relationships of the excavations to the natural deposits of the valleys, the extraction of peat must

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PHOT. 1. VERTICAL AIR PHOTOGRAPH OF RANWORTH BROAD, 1946

Much of the former mowing-marsh between the broad and the river is now covered by colonising bushes and trees, though a few areas are still cut spasmodically. Note the straight lines of bushes marking the limits of old peat-cuttings.

Phot. : J. N. Jennings

PHOT. 2. REED STACKS AT WOODBASTWICK.

Phot. : J. N. Jennings

PHOT. 3. BOLDER STACKS ON BARTON STAITHE.

obviously have post-dated the estuarine transgression by a considerable time ; but on the other hand, the great thickness of muds accumulated within the deeper basins argues against assigning too recent a period for the formation of these broads. There is no evidence, moreover, that the broads are necessarily all of similar age : indeed, it is more likely that the peat industry which formed them may well have extended over a considerable period of time.

Other Effects of Man in the River Valleys

It has already been strikingly illustrated that the present character of our Broadland region depends on the past activity of man as well as on natural geographical and biological processes which have taken place. Not only, moreover, has man created broads within the river valleys, but he has also been responsible for other modifications of the natural valley features. The most far-reaching of these changes are obviously those which have accompanied embankment and drainage of parts of the flood-plains of the rivers, with the extent of this activity again largely governed by the physiographical pattern. From the agricultural standpoint, drainage has obviously been most successful in the lower reaches of the valleys, where the estuarine mineral sediments are spread over their whole width. The surface peats, which covered these sediments at least in parts, have wasted away as a result of the lowering of the water table, so that the general level of the embanked and drained land now lies below that of the rivers and the broads : but the clay layer has prevented excessive wastage such as occurs in areas with an entirely organic substrate. The middle reaches of the valleys, where the clay forms only a partial cover, are less amenable to drainage. Apart from the greater liability to wastage, the pervious nature of the peat, which here forms the main alluvial fill, allows some lateral seepage of water ; the waterlogging is moreover aggravated by the presence of broads, with relatively deep basins, in continuity with the general river system. In most of this region the fenland therefore has remained undrained : such dykes as intersect it were cut mainly for access, transport and water circulation, and are open to the river. Attempts to drain parts of this region have generally failed as a long-term measure, and such land has

reverted to fen. The Bargate Nature Reserve in the Yare valley (Phot. 11) is an example of a previously drained area of this type (48), and another occurs adjacent to Hoveton Little Broad in the Bure.

The undrained parts of the Norfolk fenland have been exploited by man throughout the ages in a variety of ways, all of which have left their mark to a great or lesser degree. In addition to, and later than, the making of the great peat excavations, generally ten to twelve feet deep, forming the sites of broads, there has been extensive utilisation of the surface peat for fuel. This industry was still of considerable importance as late as the end of the 19th century, though it is now virtually extinct. The typical " turf-ponds " formed by surface digging were usually somewhat rectilinear in outline, and generally less than four feet deep ; most of these cuttings have now grown up again to fen, though their former limits are frequently marked by regular lines of bushes in the present fenland vegetation, as is well shown, for instance, by a comparison of Phot. 1 with Fig. 6.

Successive maps and old records, together with evidence from boring, show that a great deal of the fenland between the broads has been superficially dug for peat at one time or another. The areas covered by many of the individual turf-ponds were often as large as those of the deep excavations forming the broads themselves, as, for example, the huge, shallow cutting known as " Broad Waters " which formerly occupied much of Woodbastwick Fen. In many cases, the superficial cuttings extended directly from the edges of the deeper basins, enlarging the area of their water surface, as in parts of Hoveton Little Broad : and it has already been shown that certain of the present sheets of open water known as broads owe much of their present area, and perhaps their entire origin, to shallow peat cuttings of this type, rather than to the deeper excavations.

Apart from the utilisation of the peat itself, the natural and semi-natural vegetation of the undrained fenland has also been exploited economically in a variety of ways. Until quite recent times, most of the fens were regularly cut for hay and litter, of which a considerable bulk was sent as far afield as London for the use of cab-horses ; the firmer parts of the

fenland were often used for summer grazing after the hay had been removed ; and there was widespread harvesting of reed and sedge for thatching. These practices have inevitably left their mark on the present pattern of the fenland vegetation, largely through ecological adjustment of the plants to differences in time and intensity of cutting. Whereas winter harvesting of the reeds for thatch removes only dead stems and does not affect the vigour of the plants, annual summer or autumn mowing of hay or litter removes the living vegetative shoots, to which some plants are more tolerant than others ; thus, for example, the fen rush (*Juncus subnodulosus*) and broad-leaved sweet-grass (*Glyceria maxima*) are favoured at the expense of the common reed (*Phragmites communis*) and sedges (*Carex* spp.) (43, etc.). Moreover, regular cutting of fenland vegetation entirely checks the establishment of carr, which would normally form the climax vegetation of such areas if left alone.

Increasing labour costs during the 20th century, together with the dying out of horse-drawn traffic, have seriously restricted and made unprofitable the widespread exploitation of the fens, though small areas are still cut for local use. As a result, much of the fenland vegetation is now at a stage of rapid transition and change, with unchecked colonisation by bushes and trees. The difference between the present fenland and that of even twenty years ago was vividly described by the late Dr. Robert Gurney, in an article in the *Eastern Daily Press* (35), when he re-visited Norfolk just before he died. The "loathsome" sallow thicket, as he called it, is now in evidence almost everywhere, accompanied by alder, birch and buckthorn. Many of the areas shown as mowing-marsh in maps of the last century have now become bushy wildernesses (e.g. Phots. 1 and 11) : and the occasional finding of unexpected overgrown tracks and causeways in deserted stretches of fen and carr is now often our only indication of the former busy activity of the marshman.

Past utilisation of Broadland vegetation was not, however, confined to the firmer fenland between the broads. The encroaching reedswamps of the open water also played their part in the economy of the region. The ubiquitous reed, (*Phragmites communis*), which forms especially vigorous reedswamps in certain broads of the Yare (Phot. 6), still has a market at the present day when labour is available for its

harvest (Phot. 2) ; the bolder, or true bulrush (*Schoenoplectus lacustris*), abundant in Barton Broad (Phot. 4), has been used largely for rush mats, for which purpose limited cutting is still carried out in places (Phot. 3) ; the gladden, or lesser reedmace (*Typha angustifolia*), which fringes the great majority of the broads, was formerly used, together with the bolder, for "frail" baskets and horse-collars ; and many other less abundant plants —flags, sedges or sags, bur-reed or black-weed—all had their own specific local uses in the life of earlier generations of Broadland men.

The Character of the Natural Vegetation

Because of difficulties of access, foothold and transport, the past activities of man have been chiefly centred on the regions of solid peat, or peat and clay, around the basins of the broads, or else on the marginal reedswamp regions which could be easily reached by boat. The excessively swampy areas present in places behind the reedswamps, where the soft lake muds of the broads have been overgrown, are less accessible, and it is here that the best examples of entirely natural plant communities, unmodified by man, are found. The vegetation invading the open water of the broads typically passes through three phases—reedswamp, fen and carr—with different species forming the dominant plants at each successive stage. The reedswamp is the pioneer, growing in areas where the surface of the substrate is well below the water level throughout the year. By accumulation of mud trapped by the submerged parts of the reedswamp plants, and by the growth of peat from dead plant remains *in situ*, the substrate is stabilised and raised, so that other species can invade. When the surface has been built up to a height just above the water level, it is still occupied by mainly herbaceous plants, which form the typical primary fen phase : this fen is generally semi-floating over the loose, oozy muds below. With further consolidation of the substrate by continued peat accumulation, accompanied by the establishment of a thick fen mat by rhizome-forming species, or by the entry of tussock-forming plants, conditions sooner or later become suitable for colonisation by bushes and trees. This culminates in the eventual formation of closed-canopy, shrubby woodland known as carr.

The casual visitor to the various broads often regards the marginal vegetation as of fairly uniform type and composition, differing from broad to broad only in the relative amounts of reedswamp, fen and carr. This is by no means the case. At least three types of primary vegetational succession have been identified in the Bure broads alone (47). Here, the most uniform phase is that of the reedswamp itself, which is usually dominated by a continuous zone of lesser reedmace (*Typha angustifolia*), with patches of true bulrush (*Schoenoplectus lacustris*) and bur-reed (*Sparganium ramosum*). The common reed (*Phragmites communis*) invades the reedmace from behind as the latter advances forward, and forms the dominant plant of the early stage of the fen: the occurrence of reed itself directly at the margins of these broads generally indicates that the pioneer zone of reedmace has been artificially cut away. The chief differences between the three types of succession in the Bure broads occur at the subsequent stages, since the reed community in its turn may be invaded by either tussock sedge (*Carex paniculata*), fen sedge, (*C. acutiformis*), or saw sedge (*Cladium mariscus*). Where tussock sedge becomes dominant in the fen, its upstanding, sturdy habit allows a premature bush colonisation—chiefly of alder with occasional sallow—to take place on the tops of the tussocks themselves; the closed carr which ultimately results from this, known as "swamp carr," has a soft, unstable floor, with alternating pools and tussocks, and with many leaning trees and prostrate trunks (Phot. 7). In contrast to the tussock sedge, the fen sedge and saw sedge are both rhizome-forming plants, and build up a thicker and much more level fen mat than that produced by the tussock sedge. Trees invade the fen sedge mat at an earlier stage than that of the saw sedge, since the massive mattress of dead leaves produced by the latter plant effectively restricts the establishment of tree seedlings for a longer period of time. The carr resulting from the fen sedge succession is fairly wet, with a rather quaking substrate, and can appropriately be called "semi-swamp carr"; the saw sedge, on the other hand, gives rise to a somewhat drier type of carr—"fen carr"—with occasional ash, birch and oak as well as the dominant alder and associated sallow (Phot. 8).

In the most upstream broads of the Yare—Surlingham and Strumpshaw—the reedmace is virtually absent or plays only a minor role, and a different plant takes over the pioneer phase. This is the broad-leaved sweet-grass, or rond-grass (*Glyceria maxima*) (Phot. 5), which forms a floating mass of hover round the broads (43, 44). Its buoyant nature allows it to rise and fall with the tide, which has a considerably greater vertical range than in the broads of the Bure. Patches of marginal hover frequently break away to form floating islands, which may become established in other parts of the broads and river; where tidal scour is greatest, however, the floating sweet-grass hover is generally protected by a natural fringe of rooted reed (Phot. 6). As the substrate becomes more stable by the accumulation of mud and peat beneath the surface mat, the sweet-grass is invaded by the reed-grass (*Phalaris arundinacea*) and common reed (*Phragmites communis*) to form the fen; this in its turn gives place to a type of semi-swamp carr, similar in structure but rather different in floristic composition from the corresponding carr of the Bure.

The natural vegetation of the downstream broads of the Yare has slightly more in common with that of the Bure valley broads (49). For instance, the reedmace is prominent in parts of the Rockland—Wheatfen area, and there is some evidence from the peats that it was present in Carleton Broad before it was drained. The tussock sedge is also slightly more abundant round the Wheatfen waterways, though fen sedge and saw sedge take scarcely any part in the primary succession. Buckenham and Hassingham Broads, which are isolated from the river, are in a rather different category; they have been found to possess a range of representative examples of all the different types of succession so far identified in the broads, and this may no doubt be related to their rather chequered history of opening, embanking, and sluicing in the past.

The plant successions in the Ant, the Thurne and the Waveney broads have not yet been investigated, but preliminary observations (49) suggest that those of Barton and Alderfen Broads at least are very similar to those of the Bure; Heron's Carr, south-west of Barton Broad, for instance, is one of our best examples of typical swamp and semi-swamp carr. In broads where the daily rise and fall of flooding alkaline water

is only insignificant in extent, as in those of the tributary Ant and Thurne, the fen may show invasion above the level of the water table by more acid-loving species before progressing to carr. For instance, small patches of bog-moss (*Sphagnum* spp.) occur in the vegetation bordering Barton Broad, and a larger stretch is found at Horsey Mere. Species of bog-moss, with other acidophilous plants, have also been recorded from the region of the land-locked Calthorpe Broad, and their occurrence here related to a measured increase in the acidity of the substrate (25) ; although the data given for Calthorpe possibly applies to some bog-moss occurrences on the solid peat outside the actual basin of the broad, as well as in primary communities grown up from open water, the general principle is nevertheless the same.

The differences in plant succession which occur in the various broads appear to be related basically to differences in degree of water circulation (43, 47). This depends partly on range of tidal movement in the different valleys, partly on distances of the various broads from the rivers themselves, and partly on the number, size, and state of overgrowth of their connecting dykes. The variations in marginal species between the individual broads are also reflected in their free-floating and submerged aquatic plants, and even in the microscopic flora of their waters (1, 27). We do not yet know more specifically the precise ecological factors which cause these differences, but water analyses which are at present being carried out by Mr. D. H. Barry (1) in certain of the broads may help to throw some light upon this problem.

The circulation of tidal water, carried by a network of dykes connected with the rivers, also determines to some extent the distribution of plant communities in the solid fenland between the broads, though here its effect is superimposed on the anthropogenic pattern, resulting from man's activities, which has already been discussed. Moreover, except in areas where the dykes are relatively numerous and close together, as in much of the Yare valley, fairly large stretches of fenland are entirely removed from tidal influence, other than in times of master tides or floods. The net result is therefore a tendency to iron out floristic differences in the fenland between the different valleys, and along the individual valleys themselves,

which are so much more marked in the marginal and aquatic vegetation between the various broads. For instance, the saw sedge (*Cladium mariscus*), common in the downstream broads of the Bure but virtually absent from the open Yare valley broads, occurs in parts of the anthropogenic fenland of the Yare most removed from tidal flooding (e.g. Thack Marsh at Wheatfen), as well as in that of the Bure ; and many of the former mowing marshes dominated by the fen rush (*Juncus subnodulosus*) on the landward margin of the Yare alluvium are indistinguishable from those of the Bure in similar situations.

The Animal Life of Broadland

In general, with a few noteworthy exceptions to be mentioned later, the animal life of Broadland appears to play relatively little part in determining the pattern of the region in its widest sense, though it nevertheless forms an integral part of it. This aspect, however, lies outside the scope of the present paper, and I do not propose to discuss it fully here. The distribution of insects, crustaceans, molluscs and other invertebrates, as well as fishes and birds, must obviously be related both to the physical and vegetational differences between the individual broads and the associated fenland (3, 4, 10, 11, 30, 31, 34, 61, 62, etc.) : and, as in the case of the plants, it is probable that, with further investigation, the land-living inhabitants of the solid fenland between the broads will be found to show a generally more uniform distribution in equivalent habitats throughout the region than the more strictly aquatic forms occurring in and around the actual broads themselves.

The Future of the Broads

The present character of our Norfolk Broadland has therefore been determined by a great complexity of factors—geographical, historical and biological. We may at this point perhaps consider the possible future of the region along similar lines in terms of our present knowledge.

From the geographical standpoint, we must first evaluate the effect of probable long-term changes in the relative level of land and sea. We have already seen that the area has been affected by such a change within historical times, and the future of the region as a whole must ultimately be conditioned by this factor. Even a small rise in the level of the sea relative

Phot. : J. N. Jennings

PHOT. 4. PIONEER BULRUSH REEDSWAMP AT BARTON BROAD.

The bulrush (*Schoenoplectus lacustris*) forms a rather open community, associated with white water lily (*Nymphaea alba*). It is later invaded by the lesser reedmace (*Typha angustifolia*), seen advancing from the left in the photograph.

Note the cut stems of the bulrush in the foreground.

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PHOT. 5. FLOATING SWEET-GRASS REEDSWAMP BORDERING SURLINGHAM BROAD.

The sweet-grass (*Glyceria maxima*) forms a floating mat of hover here, which rises and falls with the tide. Where the tidal scour is only slight, *Glyceria* borders directly on the broad, as in this photograph ; where the scour is greater, it is protected by a pioneer fringe of reed rooted in the mud, as shown in Phot. 6.

Note the isolated shoots of reed (*Phragmites communis*) and leaves of the great reedmace (*Typha latifolia*) associated with the sweet-grass in the foreground, and projecting above the general level of the hover.

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PHOT. 6. ROOTED FRINGE OF REED ALONG THE CENTRAL TIDAL CHANNEL OF SURLINGHAM BROAD.

The reed (*Phragmites communis*) seen in the photograph forms only a narrow fringe, and a broad zone of semi-floating sweet-grass (*Glyceria maxima*) hover lies immediately behind it, protected by the upstanding, anchored reed.

To the right of the photograph, a small patch of detached sweet-grass hover can be seen among the reed, where it was lodged by the tide. A dense drifting mass of hornwort (*Ceratophyllum demersum*) and duckweed (*Lemna* spp.) occupies the foreground.

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PHOT. 7. ALDER SWAMP CARR AT HOVETON GREAT BROAD: DETAIL OF GROUND FLORA.

Note the base of the living alder trunk (extreme top) emerging from the centre of a massive sedge tussock (*Carex paniculata*), and the buckler fern (*Dryopteris austriaca*) growing from its side. This type of carr is characterized by much dead wood, including large, prostrate, alder trunks, of which three can be seen spanning the dark pool in the foreground: both living and dead wood are richly clothed by mosses and lichens.

The pool in the foreground is sparsely covered with lesser duckweed (*Lemna minor*), and the erect leaves of the bur-reed (*Sparganium ramosum*) growing in the pool can be seen in the centre of the photograph.

At the bottom right corner is a bush of the wild black currant (*Ribes nigrum*), a common plant of such carrs.

to the land would increase the tidal range within the rivers and broads and affect the balance of the vegetation and of the animal life, while a fall would drain the remaining open water from the broads. We have at present very little evidence from Broadland itself to indicate which way things are going. It is true that the tidal ranges commonly given for navigation purposes to-day are greater in the Bure than those published by Dr. Gurney in 1911 (32); according to local report, the tidal effect has also increased recently in the Yare. But it is possible that the widening of the bridge across the estuary at Yarmouth in 1930, together with dredging of the harbour, may be at least partly responsible for this greater influx of tidal water; this explanation is supported by the fact that Dr. J. Owen's observations in 1928 (57)—just before the new bridge was opened—generally accord with Dr. Gurney's records made more than seventeen years earlier. Outside the immediate region of the Broads, evidence from Felixstowe, in the shape of tidal observations from 1917–29 (42), suggests a sinking of the land relative to the sea; also, differences in Ordnance Survey levellings between 1850 and 1921 show southern and eastern England one and a half to two feet lower at the latter date, though the possibility of cumulative errors of this magnitude in the earlier levelling cannot be excluded (52). These data, moreover, agree with the general evidence for the behaviour of the North Sea area in Postglacial times (23), and with tidal observations for Holland (20).

Such geographical changes may, however, be extremely slow, with an effect of possibly only a few inches in the course of a hundred years. It is on other factors of more immediate impact that the future of the broads, as such, seems most likely to depend. The most obvious of these is the rapidly increasing rate of invasion of open water by encroaching vegetation. Such evidence as we have available suggests that the main overgrowth of many of the broads has taken place within the last century itself (39, 50). The original maximum extension of the open water of individual broads, determined by bores revealing the lateral limits of their muds, has been found in several of the Bure valley broads to show a rough coincidence with the limits of the broads at the time of the Tithe Survey of 1839–46, though the correspondence is less

close in the Yare. Map series* which have been produced for a number of the broads show that in fact the greatest overgrowth has taken place within the last few decades (e.g. Figs. 6 and 7). It is usual to attribute the recent loss of open water to increasing neglect, aggravated by two World Wars and rising labour costs. Greater significance should, however be attached to the interplay of natural phenomena. The basins of the majority of the investigated broads have been found to be up to ten or twelve feet deep. These peat-lined basins have, for probably many centuries, gradually accumulated organic muds within them, and the time has now come when in many cases the muds reach fairly uniformly to within four or five feet of the water surface. Conditions are thus becoming rapidly more favourable for encroachment of rooted reedswamp plants, which need the mud for anchorage and which can rarely colonise water more than four feet deep. The broads have thus at the present time reached a critical stage in their infilling, where the accumulation of an extra foot of mud in any part may give conditions suitable for the rapid spread of reedswamp vegetation. The onset of this critical stage may well be the primary reason for the widespread overgrowth of the broads within the last hundred years, in contrast to their more open nature in earlier times. If the open water of the broads as they stand at present is to be maintained, clearing of reedswamp vegetation in itself is not enough, unless repeated at progressively shorter intervals of time. Large-scale dredging must also be carried out in certain areas, to reproduce the former deeper water conditions which kept the marginal vegetation at bay.

While the foregoing is probably true for the majority of broads with a rooted, anchored reedswamp, such Yare valley broads as possess a marginal floating reedswamp of sweet-grass present a rather different picture. Here, the encroachment

*Note : A series of maps, on the lines of those shown in Figs. 6 and 7, is being prepared for all the Norfolk Broads to show their relative amount and rate of shrinkage during the last century. The diagrams for 1839–46 are reduced from large-scale maps made during the survey of Britain which followed the Tithe Commutation Act of 1836 ; the outlines for 1907 and 1908 are taken from direct tracings from the 2nd Edition of the Ordnance Survey maps : and those for 1946 are based on tracings made from Air Ministry vertical air photographs taken in that year (39, 50).

of this floating hover is theoretically unlimited, restricted only by tidal scour, and deeper water can therefore be invaded. This is probably at least partly the explanation why most of the Yare broads were more overgrown at the beginning of the 19th century than those of the other valleys, and the correlation of lake mud limits and Tithe map outlines is correspondingly less marked. Surlingham (Fig. 7) and Strumpshaw Broads, where the sweet-grass is especially vigorous, are now on the verge of extinction, though their original basins were very comparable in size and depth to those of other broads still open.

In addition to natural factors tending to reduce the depth and area of the broads, there are, however, at least some others at present in operation which act in the opposite direction, though their cumulative effect is probably relatively small. A number of these have been described by Mr. Ellis (18, etc.). For instance, the bubbling of marsh gas in the summer disturbs the organic mud of the broads so that it may be carried away by an ebbing tide ; frosts are sometimes responsible for the removal of marginal material in the tidal areas, since ice sheets binding together flood debris and reedswamp stems tend to collapse outwards with the fall of the water ; and exceptional winds and tides can cause the break-up, dispersal and even destruction of marginal hover vegetation. The effectiveness of these and other similar natural physical processes is obviously conditioned by degree of tidal movement, and possible future changes in the latter must obviously affect their operation.

Parallel with these small-scale physical factors, we must also consider future biotic effects, such as increase or decrease in the numbers of the larger Broadland birds. For instance, mute swans are responsible for pulling up large quantities of water weeds, including the rhizomes of water lilies and even reedswamp plants. There have been recently many more swans frequenting the broads than in 1940, when the practice of removing the cygnets annually fell into abeyance ; forty-four swans were recorded on Rockland Broad in the spring of 1952, and it is clear that such large numbers must result in the keeping down of aquatic vegetation to a considerable extent (E. A. Ellis, 1952, *in litt.*). Geese are also effective in checking the growth of vegetation : for instance, in the Yare valley, the

DESCRIPTION OF FIG. 6.

The map series in this and the succeeding figure are two examples of sets which are being prepared for all the Norfolk Broads to show changes in the outline of their open water during the last century. An outline map has also been added to show the position of bores which have been put down in the region ; these indicate the extent of the original basin of the broad beyond the present open water outline.

In the Ranworth series opposite, from the Bure valley, a comparison of the 1839 map with the outline showing the bores suggests that very little overgrowth of the broad had taken place, at least along the section lines, up to a century ago. This is in striking contrast to the considerable loss of open water during the last century itself ; the map series shows, moreover, that this loss has been accelerated during the latter part of this period.

The encroachment of vegetation has taken place chiefly at the western end, where the broad was originally connected with the river by a narrow dyke (now overgrown), and further eastward, towards the entrance of the wider Ranworth Dam (still open) ; in the latter region, the building up of the spit of fen now separating the Inner and Outer Broad has been encouraged by artificial piling.

The two earlier maps of the series show a number of elongated and rectilinear strips of open water extending from the broad or situated in the fenland between the broad and the river. These represent shallow peat cuttings, which have now all grown up again to fen.

FIG. 6. RANWORTH BROAD (BURE VALLEY).

DESCRIPTION OF FIG. 7.

The Surlingham map series, from the Yare valley, shown opposite, can be directly compared with that for Ranworth, from the Bure valley, in the preceding figure. In constrast to Ranworth, the former maximum extent of open water at Surlingham, revealed by the bores plotted in the fourth map, is somewhat greater than that shown in 1839, so that considerable overgrowth by vegetation must have occurred, at least in parts of the broad, before that date. Moreover, except for a small area at the eastern end, and a few small channels and pulk-holes, the open water of Surlingham Broad is now almost obliterated, although its original basin appears to have been only a little less extensive than that of Ranworth, where a considerable stretch of open water still remains.

An interesting feature of the 1839 Surlingham map is the parcelling up of the whole area between the river and the upland into narrow strips, presumably representing different individual holdings or allotments for digging peat and cutting hay, litter and reed. The alignment of these strips at rightangles to the river ensured the most equable distribution of the various types of fenland vegetation and depth of underlying peat. The corresponding 1839 map of Upton Broad (not figured) shows a similar strip-parcelling in the "Doles," immediately north of the broad.

FIG. 7. SURLINGHAM BROAD (YARE VALLEY).

edges of the floating sweet-grass reedswamp may be so closely nibbled in some parts that encroachment on open water is virtually brought to a standstill (45). The presence of numerous wild-fowl, moreover, frequently has an indirect effect in the stirring up and easing of mud away from the shoals in the broads (18).

A biological factor of very recent incidence, which may well become important in the future, is the rapid spread of the coypu rat (*Myocastor coypus*) (Phot. 9) in many of the broads. Following its original colonisation of the Yare during the last decade (51), it now appears to have become established in many other parts of Broadland (19). It has already been effective in clearing completely some small areas of reedswamp, as in parts of Strumpshaw and Wheatfen, but the relative advantages and disadvantages of its presence have not yet been fully assessed (6).

We must lastly consider the future of the region in terms of the activities of man. Again, we find we are at a critical transitional stage, with major changes in the utilisation and exploitation of the area even within living memory. It is unlikely that the undrained fens will ever again regain their economic value of the past. Unless a deliberate attempt is made to keep the vegetation open by periodic cutting, as has been done, for instance, in parts of the National Trust property at Wicken Fen, we must resign ourselves to a rapid dominance of trees and bushes. The spread of sailing and pleasure-cruising since the end of the last century has placed increasing emphasis on the maintenance of the open water rather than on the management of the fens and utilisation of the natural vegetation. The careful cutting of reedswamp plants for use has given place to wholesale clearing by mechanical means (5, 9); and whereas deliberate attempts have occasionally been made in the past to encourage the replacement of open water by fen, as in the spit of land separating the Inner and Outer Ranworth Broads (Fig. 8), and the artificial triangle at the north end of Barton Broad, the task of restoring overgrown open water is now of major importance. The increase of power-driven water traffic has had some effect in this direction itself. In those broads which are open to the public and entered by motor-launches, erosion of the margins by fast-moving craft

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PHOT. 8. MIXED FEN CARR AT HOVETON GREAT BROAD: DETAIL OF GROUND FLORA.

The ground flora of fen carr is denser and more continuous than that of the swamp carr illustrated in Phot. 7; the substrate is firmer, and there are no alternating pools and tussocks.

The trees in the background of the photograph are of alder and sallow only, though buckthorn, ash, birch, hawthorn, and even holly and oak are often present as well. The ground layer depicted includes hemp agrimony (*Eupatorium cannabinum*), woody nightshade (*Solanum dulcamara*), small reed (*Calamagrostis canescens*), meadowsweet (*Filipendula ulmaria*), and marsh fern (*Thelypteris palustris*).

Phot. : E. M. O. Laurie

Reprinted from the Journal of Animal Ecology, Vol. 15, 1946

PHOT. 9. YOUNG MALE COYPU (*Myocastor coypus*) IN THE YARE VALLEY FENLAND.

ot. : J. K. St. Joseph,
iversity of Cambridge

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PHOT. 10. OBLIQUE AIR PHOTOGRAPH OF PART OF THE BURE VALLEY, WITH HOVETON GREAT BROAD (CENTRE), PART OF WROXHAM BROAD (LEFT FOREGROUND), AND SALHOUSE BROAD (RIGHT BACKGROUND).

Note the by-passed positions of the broads in the curves of the meander bands of the river : also the contrast between the indeterminate overgrown margins of the private Hoveton Broad and the sharp eroded margins of the public Wroxham and Salhouse Broads.

Phot. : J. K. St. Joseph,
University of Cambridge

PHOT. 11. OBLIQUE AIR PHOTOGRAPH OF PART OF THE YARE VALLEY, WITH THE BARGATE NATURE RESERVE (CENTRE FOREGROUND), PART OF SURLINGHAM BROAD (EXTREME RIGHT FOREGROUND), AND ROCKLAND BROAD (CENTRE DISTANCE).

The Bargate area, lying between the broad and the river, was previously drained and used for pasture, but has now reverted to fen.

has often affected their character ; for instance, the contrast between the sharp margins of the public Wroxham Broad and the more overgrown ones of the private Hoveton Great Broad (Phot. 10) owes much to this factor.

In this inevitable change of emphasis, those who may eventually be responsible for the development and upkeep of the Norfolk Broads as a National Park are faced with many problems. Perhaps the most controversial of these at the moment is that of the possible construction of an artificial lock at Yarmouth to keep out the tidal water from the area (7, 8, 53). If this were done, we must accept the fact that the whole balance of the region would be changed. The unique character of the broads largely depends upon their water circulation ; elimination of tidal rise and fall must have far-reaching physical and biological effects. In addition to questions of silting and tidal scour, the composition, behaviour, and rate of encroachment of the vegetation round the broads, together with the associated animal life, must inevitably alter to some extent. At present we have insufficient evidence to foretell the total effect of such a change : but if the project were put into operation without further research and the most careful consideration, its long-term result might well be to destroy rather than improve the amenities of the region. The careful study of land-locked broads and even of pulk-holes* may indicate some of the effects which might be expected from such a lock. And in the same way, observation of small local phenomena may frequently give some clue to the solution of other large-scale problems of the region as a whole, as Mr. Ellis has often emphasised (15, 17). Mistakes have often been made in the past through lack of sufficient preliminary research and observation—for

*NOTE : Pulk-holes are small, relatively permanent, fenland pools, generally isolated from the main tidal system ; they are normally situated near a broad, or in the site of a former shallow peat cutting, and obviously represent residual open water left behind by advancing vegetation (47). Such pools are frequently surrounded by carr, with a characteristic margin of tussock sedge, fen sedge, or saw sedge. Their essential character lies in the absence of a reedswamp fringe, and the encroachment of vegetation within them appears to have been brought to a halt. Whether this is due to habitat changes accompanying isolation from the main bulk of tidal water, such as increased toxicity of the organic substrate, is not yet known : but similar changes, with far-reaching effects, might well be set up on a large scale in the peaty basins of the broads themselves if tidal circulation ceased.

instance, the sinking of the line of wherries in Rockland Broad to improve the tidal scour has had precisely the opposite effect to that intended (16). The Broads as they stand at present are a manifestation of natural processes at work as well as a memorial to the past activity of man ; their future remains the province of the geographer and the biologist as much as that of the administrator and the river engineer.

APPENDIX

THE SCIENTIFIC NAMES OF PLANTS MENTIONED IN THE TEXT

Reedswamp and Fen Plants

Bog-moss	*Sphagnum* spp. The most usual species found round the broads are *S. fimbriatum* Wils., *S. squarrosum* Pers. *ex* Crome, *S. plumulosum* Roll., *S. recurvum* P. Beauv., and *S. palustre* L.
Bulrush (bolder) ...	*Schoenoplectus lacustris* (L). Palla (*Scirpus lacustris* L.)
Bur-reed (black-weed)	*Sparganium ramosum* Huds. (*S. erectum* L.).
Fen rush	*Juncus subnodulosus* Schrank.
Flag	*Iris pseudacorus* L. (yellow flag) is the plant usually referred to as "flag" in Broadland. *Acorus calamus* L. (sweet flag) is much less abundant.
Reed	*Phragmites communis* Trin.
Reed-grass (soft reed, or she-reed) ...	*Phalaris arundinacea* L.
Reedmace (gladden)...	*Typha* spp. *T. angustifolia* L. (lesser reedmace) is the species found in the majority of the broads. *T. latifolia* L. (great reedmace) occurs very sparsely except in a few parts of the Yare valley.

Sedges (sags) ...	Members of the Cyperaceae.
Fen sedge	*Carex acutiformis* Ehrh.
Tussock sedge ...	*C. paniculata* L.
Saw sedge (cut sedge)	*Cladium mariscus* (L). Pohl.
Sweet-grass (rond-grass, or broad-leaf)	*Glyceria maxima* (Hartm.) Holmb. (broad-leaved sweet-grass).

Bushes and Trees

Alder	*Alnus glutinosa* (L.) Gaertn.
Ash	*Fraxinus excelsior* L.
Birch	*Betula* spp. *B. pubescens* Ehrh. is the usual species found in the Norfolk fenland, though *B. verrucosa* Ehrh. (*B. pendula* Roth.) occasionally occurs in the drier places, as, for instance, on parts of the drained site of the former Carleton Broad.
Buckthorn	*Rhamnus cathartica* L. (true buckthorn) and *Frangula alnus* Mill. (alder buckthorn).
Oak	*Quercus robur* L.
Sallow	*Salix atrocinerea* Brot. and/or *S. cinerea* L. Many of the sallows found in the Norfolk fenland show considerable overlap in discriminating characters between these two species, with consequent difficulty of precise identification.

REFERENCES.

(1) Barry, D. H. (1952). Unpublished data.

(2) Browne, F. B. (1904). A bionomical investigation of the Norfolk Broads. *Trans. Norf. & Norwich Nat. Soc.*, VII, 661.

(3) Browne, F. B. (1905). A study of the aquatic Coleoptera and their surroundings in the Norfolk Broads district. *Trans. Norf. & Norwich Nat. Soc.*, VIII, 58.

(4) Browne, F. B. (1906). A study of the aquatic Coleoptera and their surroundings in the Norfolk Broads district (second paper). *Trans. Norf. & Norwich Nat. Soc.*, VIII, 290.

(5) Buxton, A. (1949). "More Sailing Water." *Eastern Daily Press*, 9th April and 8th September.

(6) *Eastern Daily Press* (1948). "Mistaken Identity?": Second leader, 14th February.

(7) *Eastern Daily Press* (1948). "Yare Barrage": Second leader, 19th June.

(8) *Eastern Daily Press* (1948). "The Broads": Second leaders, 31st August, 15th September and 17th September.

(9) *Eastern Daily Press* (1949). "The Broads": Second leader, 28th April.

(10) Ellis, A. E. (1941). The Mollusca of a Norfolk Broad. *Journ. Conchol.*, XXI, 224.

(11) Ellis, A. E. (1942). The Natural History of Wheatfen Broad, Surlingham. Part IV. The Woodlice and Harvestmen. *Trans. Norf. & Norwich Nat. Soc.*, XV, 291.

(12) Ellis, E. A. (1935). Wheatfen Broad, Surlingham. *Trans. Norf. & Norwich Nat. Soc.*, XIII, 422.

(13) Ellis, E. A. (1940). The Natural History of Wheatfen Broad, Surlingham. Part II. *Trans. Norf. & Norwich Nat. Soc.*, XV, 115.

(14) Ellis, E. A. (1942). The Natural History of Wheatfen Broad, Surlingham. Part V. Hemiptera-Heteroptera. *Trans. Norf. Norwich Nat. Soc.*, XV, 301.

(15) Ellis, E. A. (1947). In report of joint meeting of the Norfolk Research Committee and the Norfolk & Norwich Naturalists' Society on "Broadland Problems." *Eastern Daily Press*, 3rd November.

(16) Ellis, E. A. (1948). "In the Countryside." *Eastern Daily Press*, 28th February.

(17) Ellis, E. A. (1948). In report of joint meeting of the Norfolk Research Committee and the Norfolk & Norwich Naturalists' Society on "North Sea Tides and their Effects on Norfolk Rivers." *Eastern Daily Press*, 6th December.

(18) Ellis, E. A. (1950). The Broads as a Relict Marsh. *New Nat.*, VI, 28.

(19) Ellis, E. A. (1952). "In the Countryside: The Coypus." *Eastern Daily Press*, 26th January.

(20) Escher, B. G. (1940). Het vraagstuk van de daling van den bodem van Nederland. Geologie en Mijnbouw, 173 (*ex* J. N. Jennings, *in litt.*).

(21) Godwin, H. (1934). Pollen analysis: an outline of the problems and potentialities of the method. *New Phytol.*, XXXIII, 278, 325.

(22) Godwin, H. (1938). The origin of roddons. *Geog. Journ.*, XCI, 241.

(23) Godwin, H. (1945). Coastal peat-beds of the North Sea region, as indices of land- and sea-level changes. *New Phytol.*, XLIV, 29.

(24) Godwin, H. and Clifford, M. H. (1938). The origin and stratigraphy of deposits in the southern Fenland. *Phil. Trans. Roy. Soc.*, B, CCXXIX, 363.

(25) Godwin, H. and Turner, J. S. (1933). Soil acidity in relation to vegetational succession in Calthorpe Broad, Norfolk. *J. Ecol.*, XXI, 235.

(26) Gregory, J. W. (1892). The physical features of the Norfolk Broads. *Natural Science*, I, 347.

(27) Griffiths, M. B. (1927). The phytoplankton of some Norfolk Broads. *J. Linn. Soc. Bot.*, XLVII, 595.

(28) Gurney, E. (1906). Presidential address: Limnology. *Trans. Norf. & Norwich Nat. Soc.*, VIII, 159.

(29) Gurney, E. and Gurney, R. (1908). The Sutton Broad Freshwater Laboratory.

(30) Gurney, R. (1904). The fresh- and brackish-water Crustacea of East Norfolk. *Trans. Norf. & Norwich Nat. Soc.*, VII, 637.

(31) Gurney, R. (1907). The Crustacea of the East Norfolk rivers. *Trans. Norf. & Norwich Nat. Soc.*, VIII, 410.

(32) Gurney, R. (1911). The tides of the River Bure and its tributaries. *Trans. Norf. & Norwich Nat. Soc.*, IX, 216.

(33) Gurney, R. (1911). Some observations on the waters of the River Bure and its tributaries. *Geog. Journ.*, XXXVII, 292.

(34) Gurney, R. (1929). The freshwater Crustacea of Norfolk. *Trans. Norf. & Norwich Nat. Soc.*, XII, 550.

(35) Gurney, R. (1949). Vegetational changes. *Eastern Daily Press*, 26th August.

(36) Innes, A. G. (1911). Tidal action in the Bure and its tributaries. *Trans. Norf. & Norwich Nat. Soc.*, IX, 244.

(37) Jennings, J. N. *in* Steers, J. A. (1942). The physiography of East Anglia. *Trans. Norf. & Norwich Nat. Soc.*, XV, 243.

(38) Jennings, J. N. (1952). The origin of the Broads. *R.G.S. Research Memoir*, No. 2.

(39) Jennings, J. N. and Lambert, J. M. (1950). The shrinkage of the Broads. *New Nat.*, VI, 26.

(40) Jennings, J. N. and Lambert, J. M. (1951). Alluvial stratigraphy and vegetational succession in the region of the Bure valley broads. I. Surface features and general stratigraphy. *J. Ecol.*, XXXIX, 106.

(41) Jennings, J. N. and Lambert, J. M. (1953). The origin of the Broads. *Geog. Journ.*, CXIX, 91.

(42) Jolly, H. L. P. (1939). Recent coastal changes in south-eastern England. II. Supposed land subsidence in the south of England. *Geog. Journ.*, XCIII, 408.

(43) Lambert, J. M. (1946). The distribution and status of *Glyceria maxima* (Hartm.) Holmb. in the region of Surlingham and Rockland Broads, Norfolk. *J. Ecol.*, XXXIII, 230.

(44) Lambert, J. M. (1947). A note on the physiognomy of *Glyceria maxima* reedswamps in Norfolk. *Trans. Norf. & Norwich Nat. Soc.*, XVI, 246.

(45) Lambert, J. M. (1947). *Glyceria maxima* (Hartm.) Holmb. in *Biological Flora of the British Isles*. *J. Ecol.*, XXXIV, 310.

(46) Lambert, J. M. (1948). A survey of the Rockland-Claxton Level, Norfolk. *J. Ecol.*, XXXVI, 120.

(47) LAMBERT, J. M. (1951). Alluvial stratigraphy and vegetational succession in the region of the Bure valley broads. III. Classification, status and distribution of communities. *J. Ecol.*, XXXIX, 149.

(48) LAMBERT, J. M. (1951). The ecological status of the Bargate Nature Reserve. *Trans. Norf. & Norwich Nat. Soc.*, XVII, 123.

(49) LAMBERT, J. M. (1952). Unpublished data.

(50) LAMBERT, J. M. and JENNINGS, J. N. (1951). Alluvial stratigraphy and vegetational succession in the region of the Bure valley broads. II. Detailed vegetational-stratigraphical relationships. *J. Ecol.*, XXXIX, 120.

(51) LAURIE, E. M. O. (1946). The coypu (*Myocastor coypus*) in Great Britain. *J. Animal Ecol.*, XV, 22.

(52) LONGFIELD, T. E. (1932). The subsidence of London. *O.S. Prof. Papers*, New Series, No. 14.

(53) MOSBY, J. E. G. and SAINTY, J. E. (1948). Future of the Broads, I, II and III. *Eastern Daily Press*, 27th, 30th and 31st August.

(54) NICHOLSON, W. A. (1906). A preliminary sketch of the bionomical botany of Sutton and the Ant district. *Trans. Norf. & Norwich Nat. Soc.*, VIII, 265.

(55) NICHOLSON, W. A. (1908). Proposal for a botanical survey of the Broads district. *Trans. Norf. & Norwich Nat. Soc.*, VIII, 618.

(56) NORFOLK COUNTY COUNCIL (1947). A summary report on the preservation and control of the Broads area.

(57) OWENS, J. *in* DAVIES, H. C. (1930). Tides of the river Bure. *Trans. Norf. & Norwich Nat. Soc.*, XIII, 14.

(58) PALLIS, M. (1911). On the cause of the salinity of the broads of the River Thurne. *Geog. Journ.*, XXXVII, 284.

(59) PALLIS, M. (1911). The river valleys of East Norfolk. Chap. X in *Types of British Vegetation*, ed. Tansley, A. G.

(60) SAINTY, J. E. (1949). The origin of the Broads. *Trans. Norf. & Norwich Nat. Soc.*, XVI, 369.

(61) SOAR, C. D. (1905). The Hydrachnids of the Norfolk Broads. *Trans. Norf. & Norwich Nat. Soc.*, VIII, 83.

(62) TURNER, E. L. (1922). Presidential address : The status of birds in Broadland. *Trans. Norf. & Norwich Nat. Soc.*, XI, 228.

(63) WICKEN FEN EXECUTIVE COMMITTEE (1947). A guide to Wicken Fen. 3rd Edition. *National Trust Publication.*

(64) WOODWARD, S. (1834). Bound MSS. Castle Museum, Norwich.

II

WINTERTON NESS

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Introduction.

Winterton Ness lies a few miles north of Yarmouth, and is an outstanding feature of the coastline of eastern Norfolk. Between Happisburgh and Scratby the shoreline is remarkably uniform, consisting almost throughout of a narrow and somewhat steeply shelving beach backed by a thin, but fairly continuous, line of sand dunes. At Winterton, however, there is greater complexity and the dunes, in particular, are more extensively developed, and expand into a varied system up to 600 yards wide. These dunes occur in association with the Ness, but there is some doubt as to the exact location of this feature. On Admiralty charts and also on maps of the Ordnance Survey, the term Ness* is applied to a point at the narrow northern end of the dunes. This is no longer as prominent as it was in the late seventeenth and eighteenth centuries when the Admiralty charts showed a clear change in the direction of the coastline from south-eastward to southward. The term is now more appropriately applied to the coast immediately east of the village of Winterton, where not only the main projection of dunes and beach occurs, but also an area of shallower water.

Physiographical Aspects.

The area dealt with in this paper extends from a point on the coast where the track from Winterton Holmes and alongside South Wood reaches the dunes to approximately Hemsby Gap. It falls into two major parts lying north and south of Winterton respectively. The northern part may be further separated into two fairly distinct subdivisions.

To the north of Winterton, the dunes fringe a flat area extending inland almost as far as East Somerton, and largely composed

*Although it seems likely that the name is a topographical one, it may also refer to the supposed former settlement of Nessa. But there is considerable uncertainty as to the actual position of that place.

of sandy pasture with occasional woods and low-lying areas of marsh and fen carr. Between this sandy pasture or heath and the main coastal dunes there is a belt of damp hollows or slacks. These slacks, which are of considerable interest, make a convenient inner limit of the dunes, although there is much overlapping of heath and dune. The floors of the slacks, which carry an *Erica tetralix* type vegetation, are approximately at the same level, and some three to five feet lower than the heath to the west. This in turn may be as much as 15 feet below the crests of the inner dunes, which rest on the heathy surface to the east (Phot. 1). Examinations of sections along the faces of these hollows show that the substratum of the heath consists almost entirely of sand, with dark humus layers indicating buried horizons. The axis of many of the slacks is N.N.W.—S.S.E., and since occasional most destructive gales come from a north-westerly direction it is possible that some of them have been scooped out by wind action to a horizon which the ground water approaches or even passes during the winter months. This view is consistent with the alignment of several major blow-outs in the slack belt, which appear likely to develop into hollows with impeded drainage. It is, however, noteworthy that the slack belt lies roughly parallel to what is believed to be the direction of the original coastline before progradation and recent dune formation took place (*vide infra*). The possibility cannot be excluded, therefore, that some of the hollows may have originated as depressions between beach ridges later occupied by dunes.

In the northernmost sector of these dunes there are a number of other well-developed features which must also be taken into consideration. From a width of about 400 yards the dune belt narrows within a short distance to a single ridge or embankment of planted marram. The natural dunes may reach 40 feet or thereabouts in height and have a complex arrangement. They are evidently fairly old because a number of large blow-outs occur both within the dunes and on their seaward faces, which have also suffered considerably from wave action. But where natural dunes are succeeded by a planted ridge, conditions are different. That such a ridge is unstable is shown by a comparison of air photographs taken in 1946 (Phot. 3) and 1952. Between these dates a number of potentially dangerous N.E.—


WINTERTON NESS
1952
GROYNE
BUTTS
HEATH
East Somerton
CHURCH
Winterton
LIFEBOAT STATION
LIGHTHOUSE
L.W.M.O.T.
H.W.M.O.T.
DUNE VALLEY
STEEP EDGE OF DUNES
LINE OF FORMER CLIFF
Hemsby
KEY
ERICA TETRALIX-TYPE SLACK
I - IV POSITIONS OF PITS
ACTIVE OR SEMI-ACTIVE BLOW-OUT
HOLLOW WITH SAND AND SHINGLE OR SHINGLE RIDGES
SHINGLE RIDGE
CAREX AND GRASS HEATH
MAINLY AMMOPHILA DUNES
SHINGLE FLAT WITH INCIPIENT DUNES
WOODS AND PLANTATIONS
Scale of Yards
200 0 200 400 600

S.W. blow-outs in it have been filled and replanted. There remain, however, several other active blow-outs. These are weak points which could well be extended in a gale and linked up with the inner slacks ; if an abnormally high tide occurred simultaneously with a north-easterly gale, a serious breach, even of the proportions of that at Horsey in 1938, is a possibility. As it is, measurements on the two sets of air photographs show there has been a significant retreat in the dune foot in front of the planted ridge (Phot. 2).

The slacks behind these dunes are larger than those farther south, and in part are aligned similarly to the blow-outs of the outer dunes, again suggesting a common origin. The slack at the extreme north (Phot. 6) is clearly a recent one, and beyond it there are two large but comparatively shallow blow-outs or sandy hollows which have developed since 1946. It seems very likely from the slight evidence available that both have been affected by at least a partial inundation during high tides.

Perhaps the outstanding features of this sector, however, are the slightly more elevated and drier hollows which are situated within the main dunes. Some of them may possibly have been damp slacks which were later partially filled in with blown sand. The hollows are, however, of most interest on account of the old shingle ridges which may be traced on their floors. All ridges that were visible in 1952 have been marked on the map, and it will be noticed that scanty though they may be, they are parallel with one another and with the present coast. There is little doubt that the foreland consists of a series of ridges of this type : they may be built partly of shingle and partly of sand, and occasionally enclose damp hollows. In the principal hollow, two narrow parallel slacks occupy the bottom of damp depressions on either side of the inner main ridge (Phot. 9). Sometimes similar formations can be seen on the beach, where there is relatively little shingle, which locally forms small ridges. In places, two or more distinct storm beaches with marked hollows in between may be distinguished ; the highest storm beach at the dune foot contains usually a certain amount of shingle which may be masked by later accretions of wind-blown sand. But the best example of the ridge and hollow section on the present beach is that just to the south of the present ness.

In the southern sector of the northern dunes there is an extensive series of parallel lines of dunes and three major dune valleys. Although shingle exposures are rare, it may probably be assumed that they are parts of former beach ridges and that they extend beneath some of the dunes. The homogeneous nature of the dune system suggests comparatively rapid progradation at some time in the past. The vegetation of the area is discussed in more detail below but the striking contrast between the mainly marram dunes and the *Carex* and grass heath within is noteworthy.

South of Winterton there is a line of cliff extending to and and beyond Hemsby. This cliff is well back from the sea and fronted by a remarkable valley, the eastern side of which is formed by a long line of high dunes. It would be difficult to find anything directly comparable with this dune valley elsewhere in Great Britain (Phot. 4). The old cliffs are still steep, although their lower parts slope more gently to the valley floor, and locally they are covered with sand. The steep and high dune edge is but the inner side of a considerable width of parallel dune ridges which reach to the foreshore. The height of these dunes falls seawards, and as partially indicated on the map, less pronounced and less continuous, but still reasonably distinct, valleys are found in them. Nowhere in this area is the foundation on which the dunes rest visible—not even in the great valley, the bottom of which, though fairly level, is sandy and grass covered.

At the present time (1952, Summer) the dunes are not apparently suffering any serious wave erosion south of Winterton, but if anything are extending seawards. However, to the north of Winterton, as has been indicated, there is some erosion. At Winterton itself, the point of the geographical ness is growing outwards ; opposite the old lifeboat house the edge of the foredunes is 57 yards farther seawards than on the 1938 revision of the 6-in. O.S. map. The drift of shingle and other beach material to the south is shown in the small spit extending to the southward of the ness. An extensive area of low foredunes and a large shingle flat with embryo dunes are also characteristic components of the ness (Phot. 5). The mainly sandy beach south of Winterton shelves even more steeply than is usually the case along the Norfolk coast. The tidal currents are locally

strong, especially at springs. The whole length of beach discussed in this paper is not one on which to take risks when bathing.

Historical Data

It is difficult to form a clear picture of the events preceding the formation of the present ness and of the belt of dunes in front of the cliffs to the south of Winterton. This line of cliffs indicates that erosion gave place to accretion at some not very distant time. But, unfortunately, search of relevant literature and enquiries of those who know Norfolk well have so far failed to produce much positive evidence. The early charts of this part of the coast, however, are quite useful sources of information. The earliest chart, surveyed by Captain Greenvile Collins and completed in 1689, marks the ness as a prominent feature well to the north of Winterton, and towards the present outlet of the Hundred Stream ; he also refers to " Winterton Ness sandhills ".* Between this point and Winterton is a marked embayment in the coastline, while a strip of land about 200 yards wide is shown fringing the cliffs between Winterton and Caistor. That this strip was probably an ephemeral feature is indicated by the following references in documentary sources :

1. In the Report to the Commissioners for Sea Breaches 1616 (p. 8), Christopher Aymas refers to Winterton as if the cliffs were then washed by the sea.
2. Blomefield in the fifth volume of his History of Norfolk writes of Winterton " About January 15, 1665, the high tides washing down the cliffs here . . . See London Gazette, November 20th, in 1665."
3. In a copy of the *Terrier* of all the glebes, houses, etc. . . . belonging to the Rectory and Parish Church of Winterton. 28th June 1770 :—
   " Item 26. Is a piece of land lying in Hemsby field, let to John Parker of Hemsby.
   N.B. In the old *Terriers* it is thus described :—
   Which abutts on the lands of the Lord of the Manor of Hemsby to the South, and on the sea to the north-east, and lies between the lands of Mrs. Tilney, widow, in the

**Great Britain's Coasting Pilot*, p. 18 (London, 1693 and later editions).

> east, and the Lord of the Manor of Winterton to the west ; and contains two roods good ; although the sea washes it away yearly, by undermining the bottom of that and other lands. (Extract from the *Terrier* of 1735)"

These three notes, slight though they may be, are consistent in suggesting that the cliffs were being washed by the sea, at least by storm tides, up to the beginning of the eighteenth century. It does not follow that the extract from the 1735 *Terrier* implies erosion right down to that date, but it is possible.

Collins' chart shows another significant feature—a long and narrow bank called Middle and Cockle, with depths of only four feet at low water spring tides. It lies two-thirds of a mile off-shore and runs parallel with the coast between the ness and Caistor.

Further surveys made in 1751 and 1753 agree in most respects with that of Collins. The 1753 survey by Trinity House shows features of the Collins survey on the same scale and appears to indicate a recession of the coastline and an in-shore movement of the off-lying bank over distances of about half a mile. Owing to discrepancies in the positions of the fixed points used, however, the amount of change was probably very much less. Apart from these features and the " loose shifting sand hills " marked on the 1751 survey north of the ness, neither chart gives any land details nor indicates the nature of the coastline in front of the cliffs.

The early topographical maps are also insufficiently precise on this point. Faden's and Bryant's maps show dunes in front of the cliffs. Hewitt's survey of 1827 shows a marked ness near the Hundred Stream, but from there to Hemsby the coastline is almost straight. The earlier off-shore bank had now split into two, one part with depths of four to ten feet at low water springs lying just off the ness and another narrow one named The Hood, with depths of four to nine feet at low water springs, lying 500 yards off the coastline and parallel to it, between Winterton and Hemsby. Above high water mark a thin line of dunes occupies the strip 200 yards wide, immediately in front of the cliffs ;* similar dunes occur all along the coast to beyond the ness. In 1837, the first edition of the Ordnance Survey is explicit on this

*A chart by Sayer and Bennett, dated 1781, marks these cliffs clearly, but no dunes occur in front.

point and all subsequent maps and charts agree. The ness itself is still shown in the same position on the Admiralty chart of 1837, but, on later surveys, the feature has almost disappeared from that position.

The evidence thus suggests that material travelling along the coast has been collecting at Winterton for some time. To the north of the village, this was probably a marked trend already in the seventeenth century. But south of the village it seems unlikely there were any dunes in front of the cliffs much before the end of that century or perhaps a little later. On the contrary the little evidence available suggests that the cliffs were then suffering erosion, at least occasionally. Indeed, there seems to have been some recession along the whole coast during the period following Collins' survey, and little net gain appears to have been established until well into the nineteenth century. No reason can be given why dunes had begun to gather by that time, but there are parallel examples in other parts of the east coast—the accumulation of beach and low dunes in front of the cliff north of Kessingland is one. Nor can any adequate reason be given for the formation of the pronounced valley in front of the cliffs. Possibly both phenomena are associated with the movements of the off-shore banks. The big dunes may stand on a prominent beach ridge which may have been formed during a sudden movement in-shore of the Hood bank. This led perhaps to rapid initial dune growth, and continued sand-blowing further increased the height of the dunes. But there is no proof that this happened. What seems certain is that a remnant of the Cockle bank lies further south, and no banks occur off-shore in the positions occupied by those at the beginning of the nineteenth century.*

Vegetation

The considerable size of the dune system at Winterton and the somewhat different arrangement of the dunes from those at Blakeney and Scolt Head Island suggest that they are likely to be of considerable ecological interest. Although the dunes are not exceptionally rich in species, the occurrence of four main

*Perhaps readers of this note may know of other documentary or cartographic information concerning the Winterton shore ; if so the authors would be very pleased to hear of it.

types of habitat—dunes, slacks, old shingle ridges, and sandy heath—and the continuity of the plant succession from foreshore to heath are significant characteristics. Thus the area ranks as an important counterpart of Blakeney and Scolt.

The following descriptions indicate briefly the main features of the different plant communities, but the species lists are not by any means exhaustive. It has not yet been proved possible to make any detailed transects and quadrats in the area, and these and other investigations are necessary before any attempt at a more precise analysis can be made. It is odd that such a large and interesting area has not so far been the subject of detailed systematic studies.

The Dunes. The transition from foreshore to dune is generally a sharp one—partly a reflection of the fairly steep foreshore gradients prevailing along this shoreline. The steep seaward faces of the dunes north of Winterton are evidence of the erosive action of some of the winter high tides. Under these conditions, drift line plants are not always found, but *Salsola kali*, *Cakile maritima*, and *Honkenya peploides* are fairly frequent associates in a narrow zone above the high storm beach, which is often formed of shingle. True embryo fore-dunes are almost absent in places, but accumulations of sand have been deposited on the lower parts of the eroded slopes, and exhibit the main characteristics of such dunes. They have usually a patchy but, in places, dense growth of *Ammophila arenaria*, possessing the rich dark green colour associated with young active plants of this species. Two other grasses—*Agropyron junceiforme* and *A. pungens* also occur in association with *Ammophila* on these steep faces.

The foredunes at the present ness, however, are distinct. Accretion has been rapid in the recent past, and it is also probable that only here is there any really active development of foredunes at the present time. There is a wide belt of low parallel ridges in which individual dunes rarely exceed three or four feet in height. *Salsola*, *Cakile*, and *Honkenya* occur frequently along the drift line, and also in the hollows between the incipient dunes. *Honkenya* is very abundant in places; it is frequent on both the outer and inner lower slopes of the foredunes to the south of the lifeboat house and, together with some

Plantago coronopus, carpets the floor of the dune valley or low which runs close to the foreshore. This valley is a recently enclosed part of the foreshore, since not only are the foredunes very young in places but are broken by at least two gaps. Sea water may occasionally filter through these gaps, and recent deposits of wind-blown sand are also evident in the valley. Mention may also be made of the shingle flat which occurs at the ness in front of the dune-edge. It occupies a convex part of the promontory, and embryo dunes are developing on the shingle in association with *Ammophila* and *Salsola*.

The dune system as a whole is notable for the succession of parallel ridges which it contains. There are no great differences in height, apart from the major ridge overlooking the cliff valley, and the proximity of adjacent ridges one to another suggests that their formation took a comparatively short time. The vegetation does not offer any immediate evidence of a differentiated age series; in fact, its general appearance is fairly homogeneous. Detailed, long-term study is necessary to elucidate the exact incidence of species. Nevertheless, the constituents of the *Ammophiletum* of the yellow dunes and of the grey or fixed dune communities seem to be typical. Only a short distance from the seaward edge of the yellow dunes, new species appear in the *Ammophila*. They include :—

Agrostis canina	o–f
Carex arenaria	o–f
Corynephorus canescens	r
Erodium cicutarium	o
Festuca rubra	o–f
Galium verum	f
Senecio jacobaea	f

Many of these are more frequent in hollows and on sheltered slopes. At the northern end of the dune system, where old dunes occur close to the shore, many of these species also grow near to the dune edge. In the older fixed dunes, the *Ammophila* loses its dominance. It is widely degenerate and of a dull brownish colour, but here and there fresh flowering communities occur on new deposits of sand (Phot. 1) ; the rare *Corynephorus canescens* is also locally frequent on this type of substratum. In the north, *Carex arenaria* increases in amount towards the ragged marginal zone between dune and heath, and other species include *Festuca ovina, Calystegia soldanella, Centaurium*

sp., *Luzula campestris*, and *Taraxacum* sp. Otherwise, the other components of the newer dunes occur with the same relative frequencies.

Near Hemsby, there is a *Hippophaë rhamnoides* scrub community near the crest and along the inner slopes of the outer dune ridge. Other patches also occur on the inner ridge. Owing to its small extent and the destruction caused by movement to and from the numerous beach bungalows, it would be difficult to determine its successional status. This scrub supports an interesting insect fauna.

The Slacks. The slacks or damp depressions in the rear of the northern dunes (see map) are, with two exceptions, characterized by *Erica tetralix*. The two without this plant nevertheless contain other plants with which *E. tetralix* is normally associated at Winterton. Some of the blow-outs also have one or two of these species and may well develop along similar lines, but the distinction between slacks and blow-outs is usually noticeable, ecologically as well as physiographically.

In some slacks, which are almost certainly in a seral stage, *Erica tetralix* occupies only a comparatively small percentage of the area ; in others, it is densely and widely distributed over the generally flat floor of the slack. Its distribution, and that of its most frequent associates, is obviously related to (a) differences in the ground water level, (b) the age of the slack, (c) minor variations in surface level, (d) the amount of blown sand entering the slack, and (e) the nature of the substratum and its degree of leaching. The main species represented in these slacks, which always include one or more of several *Juncus* spp., are :—

Aulacomnium palustre	o	J. bulbosus	f
Betula pubescens (seedlings)	f	J. conglomeratus	f–a
Calamagrostis canescens	o	J. effusus	f–a
Calluna vulgaris	o	J. squarrosus	f
Carex arenaria	f–a	Lotus uliginosus	o
C. nigra	f	Osmunda regalis	o
Erica tetralix	a	Polytrichum commune	f
Hydrocotyle vulgaris	o	Potentilla erecta	f
Juncus acutiflorus	f	Salix atrocinerea	o
J. articulatus	f	S. repens	o
		Sphagnum sp.	o

These species imply acid, wet conditions. *Sphagnum* communities occur in seven of the wettest slacks ; one of the best examples was in the centre of that in which pit I was dug in

(*Phot. H.A.P.J.*)

PHOT. 1. HEATH, SLACK, AND DUNE.

This illustrates the three main levels along the inner margin of the dunes. *Juncus conglomeratus*, *J. effusus* and *J. bulbosus* in slack ; *Corynephorus canescens* dominant in centre on heath surface, with buried horizon 9 ins. deep ; *Ammophila*-colonized sand and dune to right.

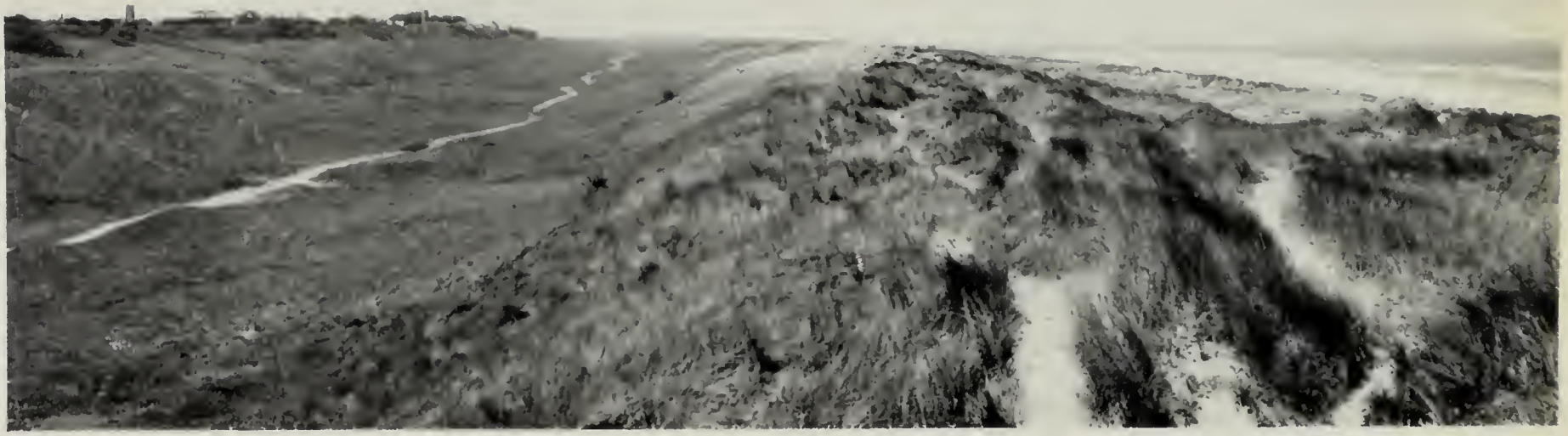
(*Phot. H.A.P.J.*)

PHOT. 2. THE NORTHERN BEACH.

Note shingle on upper beach and planted marram in front of built-up bank. High, older dunes in background.

PHOT. 3. AIR PHOTOGRAPH, 1946.

The inset shows the continuation northwards of the dunes. The breaches in the planted bank and the blow-outs and slacks stand out clearly.



(*Phot. J.A.S.*)

PHOT. 4. THE GREAT VALLEY.

(*Phot. H.A.P.J.*)

PHOT. 5. FOREDUNES AT THE NESS.

(*Phot. H.A.P.J.*)

PHOT. 6. THE NEW SLACK.

Note contrast between thinly-carpeted part towards the built-up bank and the spread of *Juncus* spp. and *Salix repens* on the left. *Typha* and *Iris* occur in the wet hole to the right.

July, 1952. The section exposed showed :—

0—2 inches.	Peat with occasional sand grains.
2—3 inches.	Brown, humus-stained sand.
3—28 inches.	Mainly greyish sand.
> 28 inches.	Layer of gravel.

Water occurred at a depth of 6 inches. The ground layer of the central zone of this boggy slack carried a considerable amount of *Sphagnum* and *Hydrocotyle vulgaris*, together with *Erica tetralix*, and tall stands of *Juncus conglomeratus*, *J. effusus*, and *Calamagrostis canescens* (Phot. 7). The last species only occurs in this slack. Surrounding this central zone and occupying the remainder of the floor of the slack is a community dominated by *Erica tetralix* with frequent *Juncus conglomeratus*, *J. squarrosus*, *J. acutiflorus*, *Salix atrocinerea*, *Betula pubescens* seedlings, and occasional *Potentilla erecta* and *Osmunda regalis*. The margins of the slack merge gradually into the surrounding lower slopes, which consist of consolidated dune grassland with abundant *Carex arenaria*, some *Ammophila* and *Agrostis canina*, also occasional *Carex nigra* and *Galium hercynicum*. *Osmunda regalis* occurs also in these and similar nearly dry situations. The whole slack occupies a very sheltered position in a deep hollow and there appears to be little irruption of wind-blown sand. It will be interesting to see what changes occur if the blow-out in the seaward edge of the dunes extends into the slack and allows the introduction of large quantities of blown sand.

A rather drier type of slack is represented where pit II was dug. Water occurred at 17.5 inches. The section showed :—

0—1.5 inches.	Peaty sand.
1.5—10.5 inches.	Pure yellowish-white sand.
10.5—15.5 inches.	Large-sized gravel with some sand.
15.5—17.5 inches.	Bleached greyish-white sand.

Gravel was found farther down. The surface adjacent to this pit is dominated by *Erica tetralix*, with which are growing some mosses. Pit III was dug in an apparently drier location in part of a slack containing *Sphagnum* patches. Water occurred at 32 inches and the section showed :—

0—1.5 inches.	Humus and dark-stained sand.
1.5—4 inches.	Yellowish sand.
4—5 inches.	Humus and dark sand.
5—32 inches.	Pure sand.

Erica tetralix is dominant in this part of the slack but *Carex arenaria* (frequent), *Lotus uliginosus*, *Betula pubescens* and *Salix repens* also occur. The sand-covered humus at 4—5 inches implies that this slack has been covered in the past by a layer of blown sand.

The most interesting slack is that in which pit IV was dug. There was only half-an-inch of humus with 30 inches of sand below it. Some gravel was found near the bottom of the section, and water occurred at a depth of 10 inches. Study of the air photographs and perhaps the presence of a heavy buoy in it both suggest it has been flooded by sea-water in recent years. This does not mean that its initiation was not the result of wind action which has also been responsible for the shallow blow-outs to the north. Much of the surface appears to be in an early state of colonization, particularly the eastern half (Phot. 6 & 8), where there is a sparse cover of *Carex arenaria*, *Juncus bulbosus*, and young *Salix repens*. The western half carries more species, including *Juncus articulatus*, *J. conglomeratus*, *J. effusus*, and *J. acutiflorus*, but even so offers an interesting contrast to the outlying piece farther to the west where there is a dense thicket of *Salix repens*, *Juncus conglomeratus*, and *J. effusus*.

There is no doubt that slack vegetation reaches a more complex stage of development in Winterton than elsewhere in Norfolk and in many respects the vegetation is unique. Most of the slacks represent various phases of wet or damp heath with *Erica tetralix* as the usual dominant. Where sand is blown in and the floor raised, the vegetation quickly becomes a type of dune grassland in which *Carex arenaria* is prominent. *Salix repens* may occasionally assist in the process. The occurrence of *Calluna vulgaris* is also sometimes associated with such dry sandy hollows. Where leaching proceeds uninterruptedly, however, the heath passes into acid bog of the *Sphagnum* type. The damp heath and bog communities have many features in common with those described by Good at Studland Heath in Dorset*.

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*" Contributions towards a Survey of the Plants and Animals of South Haven Peninsula, Studland Heath, Dorset. II. General Ecology of the Flowering Plants and Ferns." *Journ. Ecology*, 23, 1935, 361.

The Shingle Ridges. Several of the shingle ridges are traceable in hollows occupied by dune-grassland species, especially *Carex arenaria*, but the main exposures occur in the large low which extends for some 200 yards from west-south-west to east-north-east into the heart of the dunes to the south-east of pit III. There are three main ridge lines, and each of the inner ones is flanked on the west by a depression characterized by *Erica tetralix* heath. The remainder of the low is dry and is notable for the extensive development of the hair grass, *Corynephorus canescens*. The inflorescences and stems of this plant impart reddish-purple and greenish-white tints to most of the surface.

The outermost and presumably youngest ridge is in two parts, and the crest of the northern part carries an extremely open, pioneer, dry heath-type of *Corynephorus* community (Phot. 10). The large pebbles and almost pure sand constitute a very dry habitat, and the compact cushions of prickly rich green leaves of the grass do not exceed 4 cm. in height ; the flowers generally reach to between 7 and 10 cm. high. There are few other plants on this ridge, but the southern part of the outer ridge also has occasional specimens of the two lichens, *Cladonia foliacea* and *C. furcata*. The central ridge has a closer grouping of *Corynephorus*, more frequent *Cladonia* spp. and occasional *Carex arenaria*. The inner ridge bears almost a closed pattern of vegetation ; *Corynephorus* is still dominant but *Carex arenaria* and *Cladonia* are both frequent (Phot. 9). There is also one plant of *Calluna vulgaris*. The hollows in between the ridges, except those under *Erica* heath, have much closer groupings of *Corynephorus*, together with *Carex arenaria* and one or two plants of *Viola canina* ; the contrast between ridge crest and hollow is very marked.

The pattern of the plant covering on these ridges indicates an age differentiation, and the transition from a closed community on the inner ridge to an open community on the outer ridge accords well with the belief that the ridges represent successive stages in the progradation of the coastline. The ridges may be as much as 200 or 250 years old, and are thus of interest in relation to the comparable area, known as the Hood, at Blakeney Point, where Salisbury* found that *Corynephorus canescens*

*F. W. Oliver and E. J. Salisbury. " Topography and Vegetation of Blakeney Point," *Trans. Norf. Nor. Nat. Soc.*, 9, 1913.

was abundant at the edge of the old dune ridge. The Winterton ridges may well prove to be the best locality for the species in East Anglia.

The Heath. One of the most abundant species in the inland heath area is *Carex arenaria*, with which various grasses such as *Agrostis canina*, *Festuca ovina*, and *Galium hercynicum* are also associated. But it is also interesting on account of the occurrence of *Corynephorus*, which is locally abundant and is more luxuriant in growth (leaf cushions up to 11 cm., flowering stems up to 17 cm. high) than on the shingle ridges. The plant also emphasises its liking for dry habitats by colonizing recent deposits of blown sand, even where *Ammophila* is active towards the inner edge of the dune belt. The heath contains occasional small patches of *Calluna vulgaris*. Pearsall* has suggested that the establishment of a *Calluna* heath in Norfolk dune heaths may be prevented by heavy rabbit grazing.

The great valley south of Winterton also belongs to the grass-heath category. Occasional patches of *Ammophila* occur, but *Carex arenaria* is prominent among the other species on its dry floor.

There is much work to be done on the vegetation of Winterton Ness and on the relationships between the different types of communities. Certain trends are apparent, however, and they reinforce the view that the inter-relationship between physiographical evolution and the succession of plant communities is a close one.

Postscript.

Since this paper was written, considerable changes have occurred as a result of the great storm tide of 31st January, 1953. It is fortunate that the survey in 1952 makes possible a fairly accurate assessment of these changes. Breaches have occurred at two points at the north end of the dunes. The more northerly one was in front of the sandy hollows near the end of the wall, where a blow-out in the seaward face of the dune bank, which existed in 1946, had not been fully healed by 1952. The other was cut in the long blow-out leading to

*In J. A. Steers (Ed.) *Blakeney Point and Scolt Head Island* (National Trust Guide), p. 23 (London, 1952).

(*Phot. H.A.P.J.*)

PHOT. 7. DETAIL OF BOG IN A WET SLACK.

Sphagnum and *Hydrocotyle* can be seen in the centre, together with *Erica tetralix*, *Juncus conglomeratus* to the left and *J. effusus* (bottom left).

(*Phot. H.A.P.J.*)

PHOT. 8. *SALIX REPENS* AT EASTERN EDGE OF SLACK.

This zone probably represents the regular limit of standing water. Little *Salix* occurs in bare area to the right. *Carex arenaria* and, especially to left, *Juncus bulbosus* frequent.

(*Phot. H.A.P.J.*)

PHOT. 9. GENERAL VIEW OF INNER SHINGLE RIDGE.

The plant carpet is quite close, and predominantly of *Corynephorus canescens*; to the west it merges into an *Erica tetralix* slack.

(*Phot. H.A.P.J.*)

PHOT. 10. THE MOST RECENT OF THE INNER SHINGLE RIDGES.

Open community of prostrate *Corynephorus*. Note denser pattern in hollow to rear.

the slack in which pit II was made. The northern breach was not serious, and only a small amount of water entered the hollows, and the gap was soon closed by sandbags. The southern one, however, was wider, and although a good deal of water ran into the slack, the greater breadth of the dunes prevented a complete break-through.

The cemented-sandbag wall, dating from after the Horsey breach of 1938, helped to stabilize the dunes farther north. But near the southernmost groyne, severe erosion took place, and opposite the end of the wall, which was formerly flush with the dune foot, the whole dune line has been cut back about twenty-two yards to form a steep cliff of sand. All the low dunes which stood in front of the planted ridge in 1946 were being cut into in 1952; now they have entirely disappeared. This loss of foredune led to a direct attack by the sea on the two weakest points in the planted ridge, thus causing the two breaches. Although brushwood groynes 11 feet long and 3 feet high have been erected all along the foreshore in front of the ridge there are two other weak points where deep scars have been cut into blow-outs in the ridge face. These also are opposite two important slacks (pits I and IV); one of them was filled with salt water which came right over the planted bank (c.f. Phot. 6); the watermark here now seems much higher than would normally be the case with accumulations of fresh water.

Along the rest of the coast at Winterton, the foredunes have been cut away, but seldom to a depth of more than 10 yards. At one point north of the ness, fresh rooted *Ammophila* stalks showed on the beach 11 yards in front of the foot of the dunes, which had a steep 10—15 feet high "cliff" face, the top of which was perhaps a yard farther back than the foot. The three- to four-foot high dunes at the ness have been cut away or flattened for a distance of some 25 yards, the loss being more than half the accretion noted since the 6-in. O.S. map of 1905. The tide also swept into the slightly higher dunes behind for another 25 yards. In addition, the whole beach has been scoured, in places to depths of two or three feet. War-time steel beach defences near low water mark have been exposed and suggest a return to conditions as they were some twelve years ago; in the north, the peat bed, together with

the underlying boulder clay, formerly showing in patches near low water mark springs, is now exposed over a considerable length of beach.

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III

WILD BIRD PROTECTION IN NORFOLK IN 1952

Report of the Council of the Norfolk Naturalists' Trust (in Part)

CLASSIFIED NOTES.

Contributors.

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Raven.

One seen 18th March flying east over Morston/Blakeney marshes. Noted large size heavy bill, very slow wing beats followed by glide ; also heard croaking (H. H.).

Siskin

A party of twelve in an alder copse, Taverham, 9th February (M. J. S.).

Twite

First autumn birds at Breydon, 19th October (M. J. S.).

Lapland Bunting

Single birds on spring passage, 6th and 11th May. First autumn record, an immature feeding on East Bank, 2nd September. A number, up to ten, seen almost daily on the Eye field from middle of September until the end of November (R. A. R.).

Cirl Bunting

One at Cley, 29th September (Q. E. B.).

Snow-Bunting

Flocks were leaving Cley in first week of March. First autumn immigrant, 6th September. Thereafter a steady increase until the flock numbered 250—300 birds, nearly all adults. Numbers fell gradually, many immatures replacing the

adults in early November. A flock of about eighty settled down for the winter (R. A. R.).

SHORE-LARK

Four late birds by Cley Observatory, 11th May. One on 17th May. First autumn immigrants seen 12th October (R. A. R.).

WATER-PIPIT

One seen 16th January on muddy edge of creek at Morston. First attracted by the call, bigger than rock-pipit ; white chin ; pale supercilliary stripe ; warm brown mantle not heavily streaked, primaries much darker ; breast pale with sparse but strong streaking ; legs dark ; white outer tail feathers showed well when bird fluttered (H. H.).

ROCK-PIPIT

Small numbers, one to six, along creek-side, Morston, 26th—30th November (H. H.).

GREY WAGTAIL

Eight pairs bred in the Wensum, Yare and Tas valleys. Two broods were reared at Hellesdon Mill, where an adult is again wintering. (M. J. S.).

WHITE WAGTAIL

An adult in my grounds, Blakeney, 20th—22nd March. Another 5th October (H. H.). One at Cley, 25th April (A. H. D.)

BLUE-HEADED WAGTAIL

One at Cley, 26th April (A. H. D.). An adult male, Wiveton marsh, 22nd May (H. H.).

GREY-HEADED WAGTAIL

One at Cley, 11th May (W. F. B., J. F., and Col. Strutt).

GREAT GREY SHRIKE

Two, Salthouse Heath, during March (R. P. B-O., M. M.). One on Blakeney Point, 10th September (A. & C. Hitchon). One on Cley Eye, 11th September (T. & J. Hurrell). One found dead on road at Billingford, 23rd December, by A. J. Parfitt.

WAXWING

One at Weybourne, 16th November (P. R. C.). Five, Trowse Bridge, December (E. A. E.). Two on hawthorne, Runhall Common, 2nd December (Q. E. B.).

PIED FLYCATCHER

A male, 2nd May, was the only spring record for Cley. The autumn movement was also negligible compared with other years. The first bird was noted 10th August ; small immigrations on 23rd—25th August, 9th—11th September and 18th—19th September (R. A. R.).

RED-BREASTED FLYCATCHER

A male at Burnham Norton, 9th May, alighted on hemlock ; conspicuous white outer tail feathers noted in flight (S. E.)

FIRECREST

One picked up on Gorleston sea-front in mid-October by Miss Harper was sent to Mr. Peter Scott for identification.

GRASSHOPPER WARBLER

One ringed at Cley Observatory, 11th April, an early record (R. A. R.). A pair breeding in my hedge, Blakeney (H. H.).

BARRED WARBLER.

An immature at Cley from 15th—28th September. It was ringed on the 17th and seen by a number of ornithologists (R. A. R.).

RING OUZEL

One in my orchard and garden, Blakeney, 26th January (H. H.). Spring migration noted at Cromer ; a male, 9th April six males and five females 16th April ; five males and ten females 25th April (R. C.).

REDSTART

A pair breeding in Mr. B. Cozens-Hardy's woods, Letheringsett, were feeding young 15th June.

BLACK REDSTART

Breeding at Yarmouth ; male singing on bombed area, 19th April, two pairs nested there. Both pairs seen feeding young but all had left by mid-July. (Demolition in progress at the time). A male seen in same place 15th September (R. H.). A male at Stody, 12th July (H. H.).

BLUETHROAT

Up to six seen on bushes on Blakeney Point ridge 10th—17th September. One on East Bank Cley, 12th—15th September (many observers). One on Blakeney Point 3rd October (A. H. D.).

Black-bellied Dipper

One first seen on mill pool, Aylsham, Dec. 29th, is still there at time of writing, January 8th (M. Rust.)

Hoopoe

One seen near Castle Rising in mid-April by Mrs. O. Powell.

Red-rumped Swallow

First seen over Blakeney Quay, 6th March. Identified by W. F. Bishop 9th March. Last seen 22nd March a week before the blizzard. (Many observers.)

Swift

A very late bird, active and apparently well-fed, seen at Yarmouth, on 1st—3rd November in the same area (Dr. L.).

Barn Owl

A pair nesting in a derelict cattle-shed on Breydon marshland reared four young. A pair of kestrels, nesting on the ground immediately underneath the owls, reared three young. The kestrels were seen to make vicious attacks on the owls when disturbed. The young of both were flying at the end of June (R. H.).

Merlin

First year male shot on Morston Marshes 2nd January. One seen chasing a lark, Stiffkey 14th May. A male over Morston marshes 26th—30th November. A female flushed on Cley East Bank 12th October (H. H.).

Peregrine

One over Cley marsh 8th September (W. F. B.). One causing commotion among waders and gulls on Breydon 13th September (R. H.). One at Cley 30th September which was seen to take a wigeon. Immature bird Cley, 20th October (A. H. D.).

Common Buzzard

One flying over Hickling marshes 16th April (E. P.). One flying east over Salthouse 18th April (C.B.O.).

Osprey

One fishing in Blakeney Harbour 3rd May (M. M., R. A. R., J. F.). Short visits of one at Hickling 20th—25th April and

3rd—5th May (E. P., G. B.). One at Cley and Salthouse, 29th—31st August (P. J. H.).

Goshawk

An adult, looking like an enormous sparrow-hawk, flew in from the sea at Salthouse on 27th June (M. M.).

Spoonbill

One between Holme and Thornham, about 300 yards inland from the shore 13th April (Miss Whiddington). One on Rush Hills Hickling 2nd—6th May (E. P., G. B.). On 25th May an immature with black wing-tips at Breydon ; also on 14th Sept. (R. H.). An immature at Cley 15th September (A. G. Hurrell).

Glossy Ibis

An immature on partially inundated marsh Stiffkey, 16th January. There was no appearance of gloss and it was presumed to be a first winter bird (H. H.). One on Arnold's marsh, Salthouse, 24th September (P. L. G.).

Little Bittern

One seen 26th July flying in at Cley by R. A. R. Later when stalked on the marsh by W. F. Bishop it was found clinging to three reed stems three feet above the water level. This bird, a female, was seen by many observers during its prolonged stay, and last noted on 6th November by A. H. D.

On 11th August Mr. G. Crees, who is familiar with the bird in Switzerland, had a close view of one at Horsey. On 20th September one was flushed from reed-beds at Hickling by Mr. G. Bishop's dog.

Little Egret

One was seen by W. F. Bishop flying in at Cley from the east on the early morning of 7th May. It remained feeding on the marsh for four days, an adult in full breeding plumage with its crest streaming out into the breeze. (Many observers.) This bird was filmed by Mr. R. P. Bagnall-Oakeley.

Night Heron

One reported on 22nd July in Holt Hall Woods by Mr. Parling, the keeper. On 25th July W. F. Bishop had a brief view of it and was convinced of its identity.

Whooper Swan

Four on Salthouse 14th January (A. H. D.). Three, Hickling Broad, 30th January (G. B.). Three Hickling Broad 23rd February (E. P.). A party of sixteen, including seven immatures flying West, Cley 9th November (R. A. R.).

Bean Goose

Two shot from party of seven, Blakeney Harbour, 25th October. None seen on the Buckenham marshes this season.

Pintail

Exceptionally large number, up to 131 at Breydon in late February and March. A nest (unlined) with three eggs found on 11th April was deserted. A second nest with eight eggs was destroyed, probably by a grazing horse. Four young seen on Breydon Water, 10th August may have been reared on the marshes (R. H. H.).

Wigeon

A pair seen at Cley, 16th April (A. H. D.).

Mandarin

A fine male in beautiful plumage shot at Kelling by Major Cox on 10th December.

Eider

Party of eight, four males and four females, off Cley, 19th April (R. A. R.). Immature male found dead on Yarmouth beach, 9th November following northerly gales (Dr. L.). Party of eighteen including one adult male and six young males, Brancaster Harbour 5th December (Dr. J. S. Carter).

Velvet Scoter

Two flying west seen off Cley, 25th September ; three flying east, 27th September (P. D. Kirby).

Smew

Twenty flying over Hickling Broad, 5th March (E. P.). Two white males, Hickling Broad, mid-September (G. B.).

Fulmar Petrel

First seen off Sheringham, 26th January. Thirty birds was the largest number counted during the breeding season. Four

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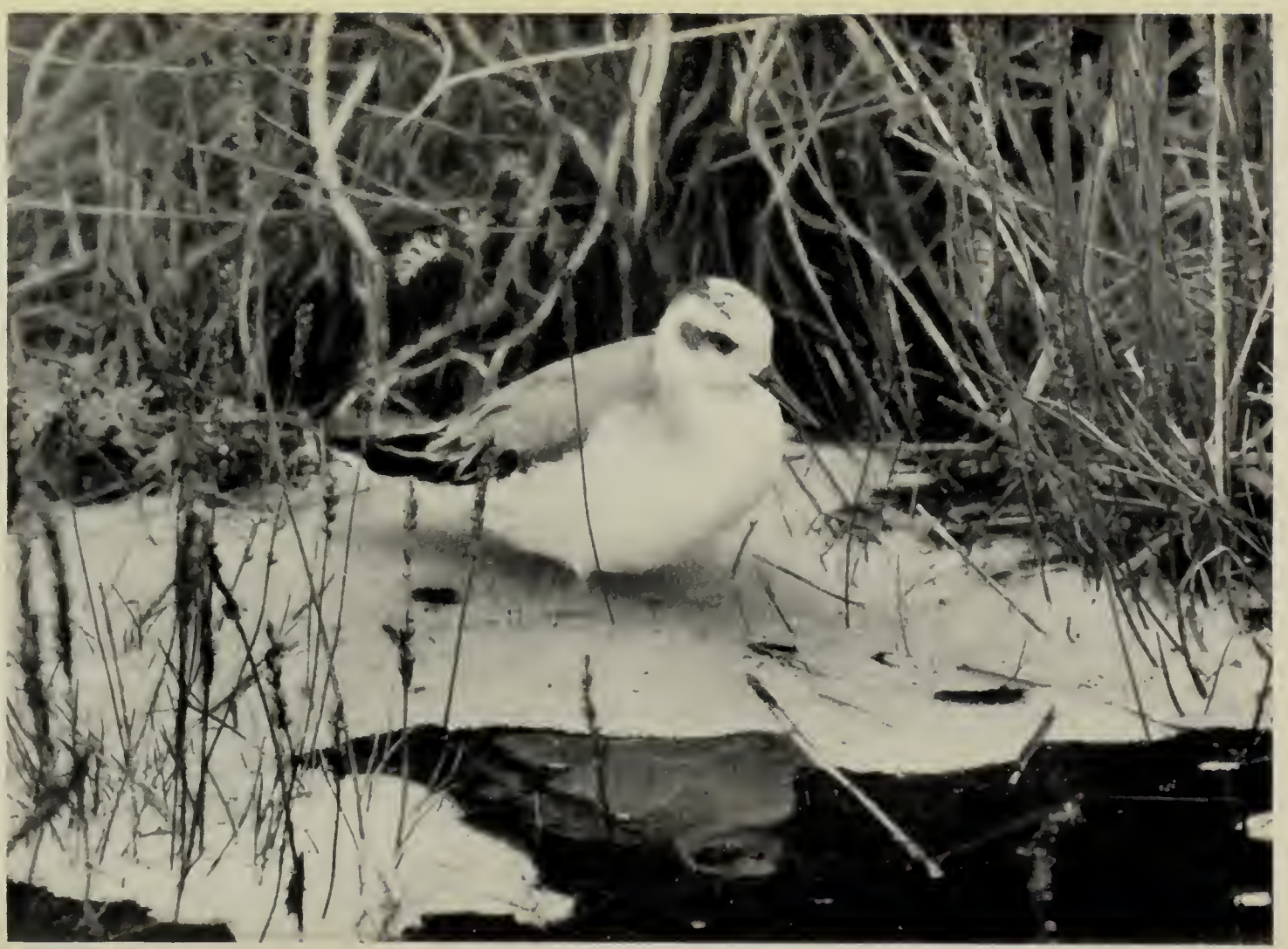
Black-Tailed Godwit with Dunlin

R. P. Bagnall-Oakeley



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Grey Phalarope, Cley Marsh.

R. P. Bagnall-Oakeley

young were reared on the usual ledges and these remained until 17th August. Twenty birds were seen over the sea on 24th December and five ledges were occupied on the cliffs west of Sheringham on 26th December, the earliest arrivals recorded here (J. & G. Marsham).

Storm Petrel

One found dead on Cley beach 8th November (P. Jackson).

Leach's Fork-tailed Petrel

One, possibly two, off Cley beach 14th October (P. Redman).

29th October—two fork-tailed swallow-like birds seen flying over road in headlights of car at Surlingham, c. 11 p.m. (E. A. E.).

31st October—One found dead at Oulton Broad (R. E. C. Dunbar).

31st October—One found sheltering in a bed of leeks at Mendham, near Harleston (Dr. F. N. H. Maidment).

2nd November—One found at Burgate, near Diss (H. G. Apthorpe).

Red-Necked Grebe

One in full breeding plumage on Rockland Broad 10th May in company with a pochard. It did not associate with the score or more great-crested grebes on the Broad (M. J. S.).

Great Northern Diver

One on flooded gravel pit, Costessey 17th November. It remained several days (M. J. S.).

Woodcock

These bred in Sheringham Hall woods and also in Kelling Woods where two broods were seen. A small migration with short-eared owls noted at Cley, 17th October (W. F. B.).

Great Snipe

A large heavy snipe with white on outer tail feathers was flushed from bracken at Sidestrand on 13th October by Mrs. Hood.

JACK SNIPE

One on Pope's marsh, Salthouse 10th September (H. H.). Five on Breydon 19th October (M. J. S.).

GREY PHALAROPE

An immature, in Half-Moon pit at Cley 4th—9th October (B. B. Riviere). It was caught and ringed on the 5th. Another immature bird ringed at Cley 7th November stayed until the 13th. A third bird arrived on 12th November and remained until 21st November (R. A. R., W. F. B., A. H. D.).

RED-NECKED PHALAROPE

A female at Cley 21st—22nd June (A. H. D.). Two immatures Cley, 26th August—6th September. (Many observers.)

CURLEW SANDPIPER

Two on mud-flats, Blakeney 26th July (H. H.).

First records at Cley 3rd May; last of season 27th September (W. F. B.).

TEMMINCKS STINT

One at Cley 9th April (W. F. B.). Two on Rush Hills, Hickling with greenshanks and common sandpiper 21st September. One in same place 4th October (E. P.).

AMERICAN PECTORAL SANDPIPER

One on Cley marsh, 28th August—4th September (A. H. D.)

PURPLE SANDPIPER

One feeding on sea aster marsh, Cley 10th September (W. Houghton). One at foot of Breydon Wall 23rd September (R. H. H.). One, Salthouse marsh, 12th November and another on Arnold's marsh 22nd—24th November (P. R. C.).

BROAD-BILLED SANDPIPER

One identified among a small flock of dunlin at Cley on 5th June. At a range of twenty yards every detail could be seen. The bird was still in winter plumage (A. H. D.).

KENTISH PLOVER

One on beach between Caister and Yarmouth 13th April (J. L.). A pair on Arnold's marsh, Salthouse 13th April (P. J. H.). Two on Yankee Ridge, Blakeney Point 18th April (H. H.).

LITTLE RINGED PLOVER

One at Salthouse 7th April (A. H. D.). A pair between the Hood and the Watch-house, Blakeney Point, 16th May (H. H.). An adult, Cley 31st September (A. H. D.).

DOTTEREL

One at Salthouse, 9th—14th August (P. J. H.)

AVOCET

Two on Breydon Water, 11th April (R. H. H.). Two on Salthouse marshes 3rd—3th May (W. F. B.). One at Salthouse, 6th June (A. H. D.). Five flew in at Cley and on towards Blakeney Harbour 26th July (W. F. B.).

LITTLE GULL

An immature on Barton Broad, 5th April (J. Boys). An adult flying east off Salthouse, 19th January and another in full breeding plumage, Blakeney Harbour 10th—22nd May (H. H.). Also a number of Cley records between 20th April and 18th November (many observers). One at Hickling 29th August, and three near Pleasure Boat, Hickling, 14th October (E. P.).

BLACK-HEADED GULL

Breeding birds on Alderfen Broad estimated at 650 pairs.

MEDITERRANEAN BLACK-HEADED GULL

An adult in winter plumage, with other gulls at sewer outflow off Sheringham from 19th November to 6th December. Slightly stockier and larger than black-headed, no black on wing-tip; feet and bill rich blood red; bill slightly heavier and more decurved than black-head; head white with bold dark mark behind eyes joined over back of crown by smudgy band of grey markings. Wings broader and less angular and flight more buoyant and languid than black-tailed. Identified by P. R. C., and seen by other ornithologists.

GLAUCOUS GULL

One sub-adult amongst a large number of gulls on Salthouse beach during a gale. (H. H., W. F. B.). An immature feeding with large gulls on Sheringham beach 17th November (J. M.). Fifteen with great black-backed gulls near Watch-house, Blakeney Point 19th November (H. H.). One almost pure white in Lowestoft Harbour, 6th December (M. J. S.).

Iceland Gull

A third or fourth year bird off Cley beach, 7th November (A. H. D.). An adult off Cley, 9th November (P. J.). One with glaucous gulls Blakeney Point, 19th November (H. H.).

Little Auk

One flying off Cley beach, 8th November (R. A. R.) and another on 30th November (P. R. C.).

Corncrake

One flushed at Hickling, 10th April (G. B.)

Spotted Crake

One flushed by dog from sheltered dyke, Caister marshes, 2nd January, and seen at close range (Dr. L.). Two on new marsh, Cley 14th August, and one on Daukes's marsh 28th August—4th September (W. F. B.). Two sheltering under bank near main drain, Salthouse, 13th November (H. H.). One flushed from ditch at bottom of the garden, Surlingham, 14th November. It took to flight in full view and landed on marshy ground which did not give immediate cover. This bird had been heard in various parts of the fen for a fortnight before it was seen (E. A. E.).

Quail

Several reports at Horsey during the summer by Major Buxton. One in field of barley flanking oats, Blakeney (H. H.).

CLEY BIRD OBSERVATORY

(Third Annual Report)

1951–1952

The Observatory's third and most successful year ended on 31st October, a month later than last year, to embrace the peak of the autumn migration. During this time several visitors took advantage of the sleeping accommodation and cooking facilities offered at the Observatory and their valuable assistance enabled the daily recording of bird migration in relation to weather conditions to be maintained from March to October inclusive. Ornithologists from Finland, Sweden, Denmark,

Australia and the United States also came to Cley and in September the Warden recorded, for the French service of the B.B.C., a short account of the Trust's work at the Observatory.

Routine trapping and ringing continued to take priority, and with four Heligoland-type traps in operation, 1,466 birds of seventy-one species were marked, and some interesting recoveries reported. A number of species appear for the first time in the Observatory ringing list, together with others previously ringed only as nestlings.

The original trap behind the beach deteriorated seriously during the year, which is not surprising considering that the tubular steel framework spent ten years on the open marshes as part of the anti-tank defences. It will have to be replaced by a wooden-framed structure before the next spring migration.

Following the policy that several small traps at different points are more profitable than one large one covering only a limited area, a second "satellite" trap was built early in 1952 behind the sea wall about two hundred yards west of the Observatory. The entrance faces east and it has proved its value many times by catching birds which have passed the main trap and, under the irresistable urge to migrate westward along the coast, will not permit themselves to be diverted back even for so short a distance. Black redstart, stonechat, garden-warbler, blackcap and corn-bunting, appear among its list of captures.

The 1951 " satellite " over the rubble dump a hundred yards east of the Observatory also faces east and has accounted for a number of interesting birds, including black redstart, whinchat, swallow, pied wagtail, wheatears, whitethroats, robins and linnets.

The largest trap of the four is the one constructed last year (1951) in the dense and sheltered blackthorn thicket on the Salthouse boundary by kind permission of the Norfolk County Council. It is proving an outstanding success, having caught barred warbler, wryneck, long-eared owl, woodcock, nightingales, red-backed shrikes and ninety whitethroats (including a German-ringed bird). Proof that our trapping activities have no adverse effect on the birds there can best be shown by the fact that turtle-doves, shrikes and a dozen other species continue

to nest unperturbed within a few yards of the trap. One enterprising wren even built a nest inside the entrance funnel!

In an attempt to ring some of the bluethroats and other small migrants in the suaeda bushes on the beach, a portable trap, similar to the Fair Isle " Yeoman net," was devised and, although arriving too late in the season for use as planned, immediately justified itself by the unexpected distinction of catching a grey phalarope.

The series of brushwood bushes in the Observatory precincts remains the only available cover for migrants coasting along the beach or arriving from the sea, for all but a few of the shrubs and trees planted have succumbed to the elements. Gifts of shrubs for covert are still being received, and experimental planting continues.

In addition to the re-trapping this year of birds ringed in previous seasons (it is always a thrill to recover these and to speculate on their journeys in the intervening months), two of the robins ringed during the phenomenal invasion from the Continent in October, 1951, have been reported—one from winter-quarters in Minorca and the other from north Germany this spring, possibly in its native locality, or perhaps still moving north. A third robin, ringed in October, 1950, was recovered in east Spain last winter at a place not very far distant from Minorca (see " Recoveries ").

The Warden's study of the local meadow-pipit population was temporarily suspended during the year owing to pressure of other work, but at least four colour-ringed birds returned to nest in the area—one of them for the third year running.

So many people have helped the Observatory in various ways that it would be impossible to thank them individually, but their kindness and interest is nevertheless much appreciated.

R. A. Richardson

(Warden of the Observatory).

RINGING PROGRESS

Species	Seasons 1949–1951	Season 1951–1952 Trapped	Nestlings	Total	Grand Totals
Starling	144	11	1	12	156
Greenfinch ...	123	140	0	140	163
Goldfinch	9	4	0	4	13
Linnet	144	33	0	33	177
Bullfinch	0	1	0	1	1
Chaffinch	119	50	3	53	172
Brambling ...	37	6	0	6	43
Corn-Bunting ...	0	1	3	4	4
Yellow Bunting ...	13	10	8	18	31
Reed-Bunting ...	42	94	10	104	146
Snow-Bunting ...	148	0	0	0	148
House-Sparrow ...	206	79	6	85	291
Tree-Sparrow ...	26	0	0	0	26
Wood-Lark ...	9	0	3	3	12
Skylark	76	1	23	24	100
Tree-Pipit ...	3	0	4	4	7
Meadow-Pipit ...	103	9	56	65	168
Rock-Pipit ...	5	0	0	0	5
Yellow Wagtail ...	15	0	11	11	26
Pied Wagtail ...	7	3	0	3	10
Tree-Creeper ...	0	0	3	3	3
Great Tit	29	17	0	17	46
Blue Tit	116	45	0	45	161
Coal Tit	9	0	0	0	9
Red-backed Shrike	15	3	8	11	26
Spotted Flycatcher	7	0	5	5	12
Pied Flycatcher ...	21	0	0	0	21
Goldcrest	2	9	0	9	11
Chiffchaff	0	5	6	11	11
Willow-Warbler ...	37	30	17	47	84
Wood-Warbler ...	0	0	7	7	7
Grasshopper-Warbler	0	1	0	1	1
Reed-Warbler ...	13	6	5	11	24
Sedge-Warbler ...	16	2	5	7	23
Barred Warbler ...	0	1	0	1	1
Garden-Warbler ...	0	2	0	2	2

Species	Seasons 1949–1951	Season 1951–1952 Trapped	Nestlings	Total	Grand Totals
Blackcap	8	4	0	4	12
Whitethroat ...	68	91	10	101	169
Lesser Whitethroat	6	5	0	5	11
Fieldfare	2	1	0	1	3
Mistle-Thrush ...	2	0	4	4	6
Song-Thrush ...	119	27	23	50	169
Redwing	1	6	0	6	7
Bleckbird	188	81	12	93	281
Wheatear	37	23	0	23	60
Whinchat	2	5	0	5	7
Stonechat	0	5	0	5	5
Redstart	14	17	0	17	31
Black Redstart ...	10	5	0	5	15
Nightingale ...	13	3	15	18	31
Robin	78	203	1	204	282
Hedge-Sparrow ...	63	67	0	67	130
Wren	7	18	0	18	25
Swallow	38	6	38	44	82
House-Martin ...	7	1	2	3	10
Sand-Martin ...	0	1	0	1	1
Swift	2	1	5	6	8
Nightjar	2	0	1	1	3
Wryneck	0	1	0	1	1
Cuckoo	1	0	1	1	2
Little Owl ...	2	0	0	0	2
Long-eared Owl ...	0	1	0	1	1
Barn-Owl	7	0	5	5	12
Bittern	2	0	0	0	2
Sheld-Duck ...	2	1	0	1	3
Wood-Pigeon ...	1	0	2	2	3
Stock-Dove ...	3	0	2	2	5
Turtle-Dove ...	3	0	3	3	6
Woodcock ...	1	2	0	2	3
Common Snipe ...	0	1	0	1	1
Grey Phalarope ...	0	1	0	1	1
Dunlin	6	0	0	0	6
Redshank	20	0	2	2	22

Species	Seasons 1949–1951	Season 1951–1952 Trapped	Nestlings	Total	Grand Totals
Ringed Plover ...	39	0	3	3	42
Lapwing	19	1	3	4	23
Oyster-Catcher ...	7	0	0	0	7
Common Tern ...	5	0	3	3	8
Little Tern ...	5	0	0	0	5
Black-headed Gull	29	0	3	3	32
Razorbill	1	2	0	2	3
Guillemot	1	1	0	1	2
Totals ...	2,314	1,144	322	1,466	3,780

1949–50 : 1,254 birds of 60 species
1950–51 : 1,060 birds of 57 species
1951–52 : 1,466 birds of 71 species
1949–52 : 3,780 birds of 81 species

RECOVERIES

(All were ringed at Cley unless otherwise stated)

STARLING

SX 798, ringed by P. R. Clarke at Sheringham, 16.10.50 ; found dead at Gröningen, Holland, 12.4.52.

LINNET

LD 403, ringed as a nestling by Graham Byford at Bodham, Holt, on 28.5.52 ; shot in Landes, S.W. France, 23.10.52.

CHAFFINCH

(Almost certainly wintering Continental birds).

Female, L 8218, ringed 27.1.51 : re-trapped 15.3.52.

Female, ME 704, ringed 24.10.51 ; re-trapped by P. R. Clarke at Sheringham, 9.2.52.

Female, MF 033, netted at roost, Salthouse Heath, 2.12.51 ; re-trapped there 16.3.52.

Female, MF 052, netted at roost, Salthouse Heath, 2.3.52 ; killed by traffic at Cley, 3.4.52.

Female, MF 088, ringed at Observatory, 14.2.52; netted at roost, Salthouse Heath, 16.3.52.

MEADOW-PIPIT

(Local breeders are probably all summer visitors).

J 6030, colour-ringed as adult, 18.6.50; returned to breed in 1951 and again on 23.3.52.

NR 544, colour-ringed as nestling, 10.7.51; seen on breeding territory at Cley, 12.5.52.

NR 545, colour-ringed as nestling, 10.7.51; seen on breeding territory at Salthouse, 11.4.52.

(*Note:* Both these birds were from same brood).

NR 694, colour-ringed on 9.9.51; returned to breeding territory 21.3.52.

WHITETHROAT

NF 0662, ringed as nestling at Kelling, Norfolk, 14.6.51; re-trapped at Salthouse, 13.5.52.

NR 560, ringed as juvenile at Salthouse, 23.7.51; re-trapped there 13.7.52.

NR 620, ringed at Salthouse, 12.8.51; re-trapped there, 16.7.52.

NS 529, ringed as nestling by P. R. Clarke at Cley, 29.7.51; re-trapped at Observatory, 2.8.52.

Adult male, "Vögelwarte Helgoland, 9435010," ringed on Wangeroog, E. Frisian Is., 29.4.52; re-trapped at Salthouse, 27.6.52.

(*Note:* Bird's wings and tail much abraded with new inner primaries "in the sheath." Possibly a local bird ringed on spring migration through Europe, but evidence inconclusive).

BLACKBIRD

Male, S 5396, ringed as nestling by P. R. Clarke at Salthouse, 3.6.51; re-trapped there 13.7.52.

CONTINENTAL ROBIN

J 6155, ringed 21.11.50; found dead in Castellôn, E. Spain, 7.1.52.

NS 574, ringed by P. R. Clarke at Cley, 2.10.51, when unprecedented " invasion " of wind-drifted immigrants exhausted Observatory's stock of rings ; found dead in Minorca, Balearic Is., early March, 1952.

NR 724, ringed 1.10.51 ; found dead at Elsten, Kloppenburg, N. Germany, 28.3.52.

British Robin

MJ 223, ringed as nestling by P. R. Clarke at Kelling, 6.5.52 ; re-trapped at Cley, 31.8.52, and wintered there.

Nightingale

NJ 945, ringed as nestling by P. R. Clarke at Kelling, 10.6.51 ; shot at Portimaõ, S. Portugal, 25.9.52.

(*Note :* NJ 946, a nestling from the same brood, was re-trapped at Salthouse on 12.8.51. See " W.B.P.N., 1951," p. 21.)

Stock-Dove

345, 368, ringed as nestling by P. R. Clarke at Kelling, 22.8.50 ; killed, probably by dog, where ringed, October, 1952.

R. A. Richardson

(Warden).

GREY WAGTAILS NESTING IN NORFOLK

Grey wagtails were seen on many occasions frequenting the upper reaches of the River Yare in 1949 and 1950. In May 1951, a pair observed feeding two young birds led to the discovery of one recently vacated nest and two older nests under Coston Bridge, while a third young bird was found dead on the road nearby. These nests were lined with white horse hair, as were all of those found subsequently. A few days later the hen had laid an egg in the current season's nest, after cleaning and renovation, and the clutch was made up to five ; but this nest was eventually deserted, it is thought most probably because of children playing under the bridge. As the result of observations made by Mr. M. J. Seago and the writer, it appears likely that at least two other pairs nested elsewhere on the upper Yare in 1951 ; a pair and young were seen at Marlingford and a pair frequented the vicinity of Keswick Mill throughout the summer. In addition, odd birds were seen in the course of the same year at Hardingham and Trowse Mills on the Yare ; at Aylsham, Burgh, Oxnead, Buxton and Horstead Mills, on the Bure ; at Lenwade, Taverham, Hellesdon and New Mills (Norwich) on the Wensum, and a single male at Burnham Overy Mill (River Burn) in August.

The following nesting records of 1952 and the fact that grey wagtails were seen in many parts of the county at all seasons show that the status of this species in Norfolk is now that of a resident and not, as indicated by Witherby, only a winter migrant.

River Yare

Coston Bridge : New nest 4.4.52 ; ultimately 5 eggs, then deserted ; two females seen 20.4.52, nest (old) found on 28.4.52 containing nine eggs, obviously laid by two hens seen earlier, eggs deserted. New nest found 8.6.52 with one egg ; again deserted.

Barnham Broom Mill. Pair seen feeding young 10.5.52 ; second nest with female brooding found 24.5.52.

Marlingford Mill. Female found building nest (male accompanying) 10.4.52 ; eventually two young seen ; no record of second brood, but old birds remained in vicinity.

Bawburgh Mill. Pair seen 13.4.52. Four newly hatched young found 6.5.52.

River Wensum

Hellesdon Mill. Nests not found, but two broods raised successfully and seen being fed by parents on many occasions.

Taverham Mill. A pair nested but later deserted (L. W. Lloyd); two young seen in early July, may have come from Hellesdon.

Bintry Mill. One pair; two broods raised (T. W. Irvine).

River Bure

Buxton Mill. Female seen 19.4.52; two young seen 17.5.52. Old nest found in ivy over storm sluice.

River Tas

Stoke Holy Cross Mill. Nest found 1.5.52; pair bred, though no young seen (M. J. Seago).

Rivers Wissey and Little Ouse

It was not found possible to keep these under observation, but grey wagtails were seen in both during March and may have nested.

River Waveney

Several visits made in 1952 revealed no grey wagtails at any of the more likely places.

It is hoped to continue the investigation of the breeding of this species in 1953 and the assistance of other observers would be greatly welcomed.

E. Q. Bitton.

IV

OBSERVATIONS ON *NAJAS MARINA*—I

By D. H. Barry and A. C. Jermy.

Distribution.

Najas marina is widely distributed over the world, although it is absent from tropical Africa, South Africa and the colder regions of the globe. It occurs most abundantly in temperate Europe and Asia, tending to be rare elsewhere. In America it is widespread but very local, becoming perhaps more common in the south-western states.

Its present distribution in Britain is said to be governed by climate, and it is only known from certain of the Norfolk broads. In earlier times it was much more widespread in occurrence, as is shown by the discovery of fossil seeds at Barry Docks, Glamorgan; Hitchin, Hertfordshire; Pakefield and Corton in Suffolk, and Beeston in Norfolk.

The only British records for the living plant prior to 1949 were from Hickling Broad, Whiteslea and Heigham Sound, where it was first found by Bennett in 1883; also from Martham Broad, where it was found by Hanbury and Holmes two years later, and from Somerton Broad, where Mennell found specimens at about the same period. The first hint of its spread was in 1949, when Mrs. D. T. Boardman found some plants growing in a small bay off Barton Broad. It was first reported from Upton Broad in 1951 by members of the British Ecological Society, but not verified until 1952. The other two broads where it was found in 1952 for the first time are Blackhorse Inner Broad (Hoveton Little Inner Broad) and Alderfen Broad. All the above mentioned areas, except Somerton Broad, were examined by one or both of us, and the only station it was found to be absent from was Martham Broad. Only the South Broad was accessible, and despite a prolonged search (J. M. Lambert, D.H.B.) no specimens were found. It is likely that the North Broad provides a more suitable habitat, and it is hoped access will be obtained to it next summer. In Alderfen Broad the only specimen found was a single detached floating branch; in all the other broads vigorous growth occurs.

HABITAT AND ECOLOGY.

Little has been published, either in this country or abroad, about habitat conditions, except that *Najas marina* usually occurs in salt springs or brackish water, which may be from 0.5 to 15 metres deep. The Norfolk specimens are rooted in a soft nekron mud, in more or less transparent water, ranging from about 0.4 to 2 metres in depth. The plants are often smothered by a deposit of mud, but appear to be none the worse for such a covering. The roots are long, with well developed root hairs, and the plant no doubt obtains many of its mineral requirements from the substratum.

Salinity of the water (expressed as parts per million of $NaCl$) ranges from a minimum of 85 in Upton Broad to a maximum of 2,800 in Hickling Broad. During the sea floods of 1938 the salinity of Hickling rose to the region of 32,000, and all the *Najas* plants are said to have been killed ; whether directly by the high salt concentration, or as a result of being smothered and uprooted by conditions following the flooding is not known. The complete recovery exhibited by the plant was probably from seed which withstood the unfavourable conditions.

Alkalinity, expressed as parts per million of $CaCO_3$, ranges from 100 (Hickling) to 240 (Upton). All the broads are just alkaline in reaction, having a mean pH of about 8.0.

Najas marina often forms large beds several square metres in extent. In several areas (e.g. Blackhorse Inner Broad, parts of Upton Broad) it colonizes bare patches of mud. In Barton Broad it tends to grow on the naked mud in scattered clumps, which often have hollow centres. These formations probably result from the branching of a single plant, and are very likely an early stage of colonization. At Upton Broad *Najas marina* is abundant in the open water, and also in the *Phragmites communis* reedswamp. It also occurs amongst the *Myriophyllum verticillatum* where the latter does not grow too densely. In the Hickling area it competes successfully with the larger *Charas*, and it does not appear to have altered its status there since Bennett first described it.

Once established in an area of water it appears that the extreme brittleness of the plant, together with the ease detached portions take root, will ensure a rapid spread. Several mallard

were disturbed from shallow water in Blackhorse Inner Broad, and the area they left was littered with uprooted plants of *Najas*. Fruits, each containing a single fertile seed 2—5 millimetres long, are freely produced, and it is likely that some of these are eaten by duck. Seeds have been found in the crops of American specimens of widgeon, blue and green-winged teal, pintail and pochard. Whether the seeds are still viable after passing through these birds is not known, but, if they are, their germination is a possible explanation of the sudden appearance of the plant in suitable, virtually landlocked waters. There is, too, the possibility that seeds or small portions of the plant may be carried on the bills or feet of wildfowl and other water-frequenting birds.

The method of overwintering presents another problem. Fruiting plants brought into the laboratory during October disintegrated as in nature, forming a characteristic organic mud. Just before the whole plant broke down the pericarp fell away, and the seeds were shed onto the bottom of the aquarium, where some of them soon germinated under their thin covering of mud. At the date of writing (November 1952) germination has made only slight advances, but observations of its progress will continue to be made. It is realized that laboratory conditions are far different from those of the natural habitat, but these observations on germination may shed some light on the method of overwintering.

Conclusion.

In this short paper we have tried to bring together what little is known about the ecology of *Najas marina*, together with some original observations, including its present distribution in this country. We should like to express our thanks for help with the literature to both Mr. E. A. Ellis, of the Castle Museum, Norwich, and Mr. J. E. Dandy, of the British Museum (Natural History).

REFERENCES.

Distribution of *Najas marina* :

Bennett, A. (1883). *J. Bot.*, 353.

Bennett, A. (1884). *Trans. Norf. & Nor. Nat. Soc.*, III, 634.

Bennett, A. (1909). *Trans. Norf. & Nor. Nat. Soc*, IX, 47.

Britten, J. (1900). Distribution of Najas marina, *J. Bot.*
Ellis, E. A. (1950). *Trans. Norf. & Nor. Nats. Soc.*, XVII, 137.
Ellis, E. A. et al. (1938). The effect of the Horsey sea floods, *Trans. Norf. & Nor. Nat. Soc.*, XIV, 359.
Fassett, N. C. (1940). *Manual of Aquatic Plants*, p. 77.
Muenscher, W. C. (1944). *Aquatic Plants of the United States*, p. 67.
Nicholson, A. W. (1914). *Flora of Norfolk.*
Pascher, A. (1936). *Die Süsswasser-Flora Mitteleuropas*, Heft 15, p. 78.

General :

Kubichek, W. F. (1933). Report on the food of five of our most important Game Ducks. *Iowa State Coll. Journ. Sci.*, 8, No. 1, 107—126.
Mabbott, D. C. (1920). Food habits of seven species of American Shoal Water Ducks. *U.S. Dept. Agri. Bull.*, 862.
Rendle, A. B. (1899). Revision of the Genus Naias. *Trans. Linn. Soc.* Series II, Vol. V.

V

A NEW PLANT FOR NORFOLK.

By Eric L. Swann

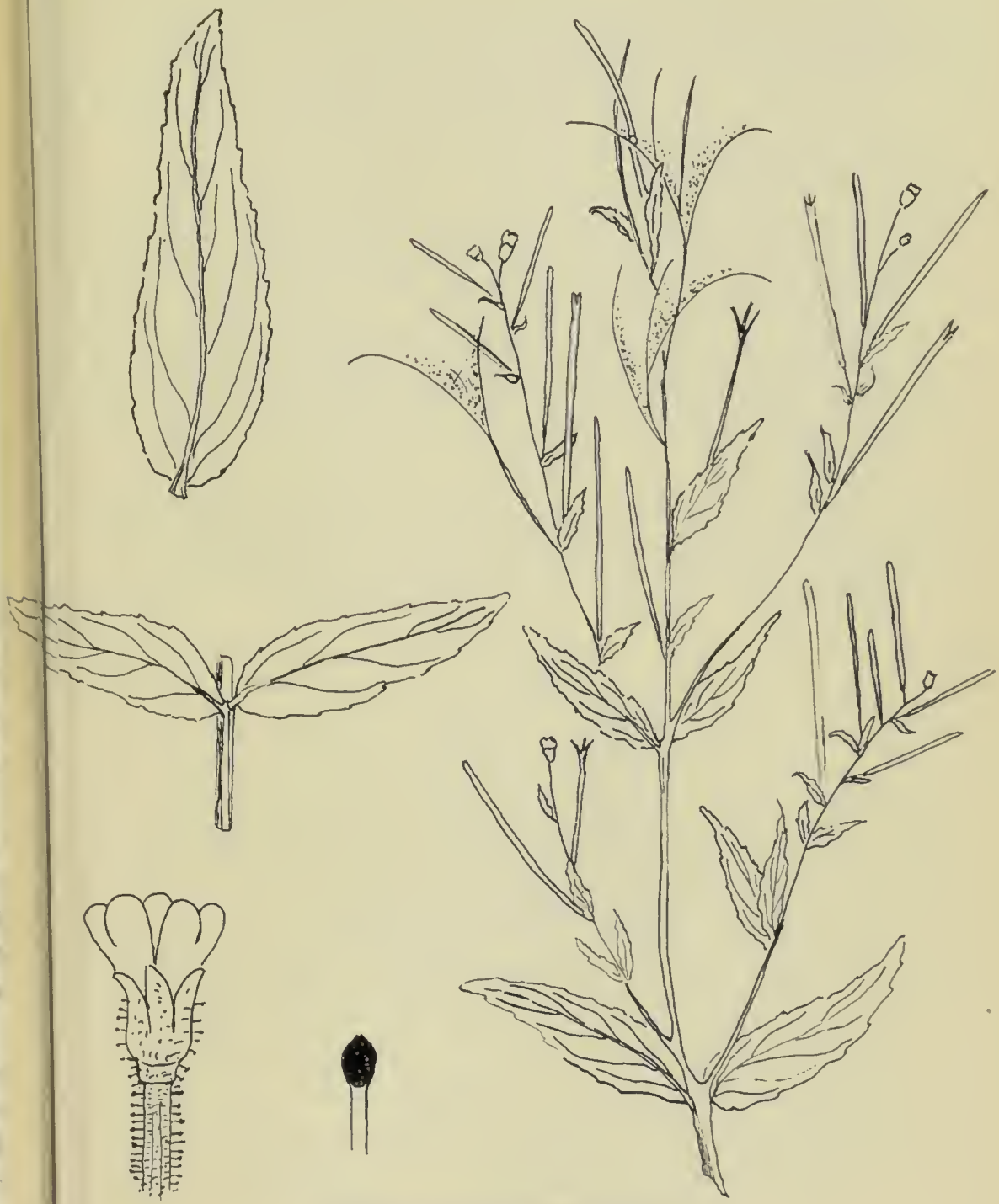
The finding of a new plant in such a large county as Norfolk is not remarkable when one takes into account the large influx of aliens through the agency of American carrot-seeds ; what does give some cause for surprise is the fact that such a plant should have escaped detection for so long as the first record in Britain goes back to 1894.

It is quite possible that this new species of willow-herb (*Epilobium adenocaulon* Hausskn.) may have been overlooked and careful searching in damp woods, streamsides, gardens, and waste places would reveal many more colonies. Like several other aliens from North America it appears to be spreading very rapidly.

Among the willow-herbs there are some very abundant and familiar species such as Codlins and Cream (*Ep. hirsutum* L.) and Rosebay or Fireweed (*Chamaenerion angustifolium* (L.) Scop.) but among the small-flowered species there are several which are not so well-known.

Form of the stigma, leaf-shape, and indumentum or clothing of the upper parts of the stem bearing the inflorescence are the characters upon which diagnosis is based yet it is the last of these, the indumentum, which provides the most useful character for accurate determination of closely allied species. It is the " quality of the pubescence " which counts.

The writer was first attracted by the tallness (four feet) of a very upright plant considerably branched in the upper part and bearing an abundance of very small flowers and small, spreading pods. The short, club-shaped stigma ruled out *Ep. parviflorum* and *Ep. montanum* and a tentative determination put it in the " *tetragonum* " group. Viewed through a lens the erect, glandular hairs of the upper parts were very noticeable, and it is the admixture of these glandular hairs with crisped ones which provide the most positive character in the field in July.



Epilobium adenocaulon Hausskn.

The small-flowered willow-herb (*Ep. roseum* Schreb.) might be confused with this species as it also possesses an entire stigma and spreading, glandular hairs ; but the leaves are decidedly stalked and the flowers are whitish then streaked with pink later. The abundance of the glandular hairs should prevent any confusion with the closely-allied *Ep. adnatum*, *lamyi*, and *obscurum*.

At Horningtoft the new species was found growing with *Ep. montanum* and *Ep. hirsutum*. The station is damp woodland overlying boulder clay. It has also been found at East Lexham by the streamside which is one of the arms of the River Nar ; in disused gravel-pits at Tottenhill ; abundantly in woodland at Houghton ; and at Docking. It is thought very probable that it will be found to be as abundant in Norfolk as it is in Surrey.

The writer is very grateful to Mr. Gerald M. Ash, the willow-herb expert, for his confirmation of the original find ; and to his wife for the accompanying line-drawing.

MEMBERSHIP.

Candidates for ordinary membership may be nominated and elected at any meeting of the Society ; three dissentient votes shall exclude a candidate.

The annual subscription is fifteen shillings, payable on election or at the beginning of each financial year (April 1st) to the Hon. Treasurer, D. A. P. Gould, 8, Upper King Street, Norwich, who will supply a banker's order form for this purpose on request. Members may instead pay a life composition fee of £12.

Every member is entitled to receive one copy of the *Transactions* as published annually ; to attend the meetings and excursions and to make use of the Society's library. Members may bring friends to meetings.

Enquiries should be addressed to the Honorary Secretary, F. J. T. Page, Castle Museum, Norwich, to whom also applications should be made for back numbers of the *Transactions*.

MATERIAL FOR PUBLICATION.

The Hon. Editor will be glad to consider papers, preferably on Norfolk natural history, for the *Transactions*. These should aim at clarity of expression and should be typewritten. Such contributions should reach the editor by the end of September. The cost of a reasonable number of illustrations will be borne by the Society, but where great expense is likely to be incurred it is hoped that authors will endeavour to share the cost, by obtaining grants or otherwise. Authors receive 25 off-prints of their papers free and further copies may be ordered in advance either through the Hon. Secretary or the Soman-Wherry Press Ltd., Heigham Street, Norwich, from whom an estimate of the cost can be obtained.

CHANGE OF ADDRESS.

Prompt notification of members' changes of address will greatly facilitate the work of the officers of the Society.

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TRANSACTIONS

OF THE

Norfolk and Norwich

NATURALISTS' SOCIETY

FOR THE YEAR

1953

VOL. XVII PART V.

EDITED BY E. A. ELLIS

NORWICH
PRINTED BY THE SOMAN-WHERRY PRESS LTD, NORWICH.
1954

PRICE 10/-

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J. E. SAINTY, B.Sc.	1950—51
DR. J. M. LAMBERT, M.A., F.L.S.	1951—52
R. P. BAGNALL-OAKELEY	1952—53

TRANSACTIONS

OF THE

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VOL. XVII PART V.

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NORWICH

PRINTED BY THE SOMAN-WHERRY PRESS LTD., NORWICH.

1954

Norfolk and Norwich Naturalists' Society

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HER MAJESTY THE QUEEN

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K. C. DURRANT
E. T. DANIELS
(retiring 1954)

Ex-officio

R. R. CLARKE

Norfolk & Norwich Naturalists' Society

LAWS (1954)

SECTION I.—Name and Objects

1. The Society shall be called the "Norfolk and Norwich Naturalists' Society," and shall have for its objects :—

   (*a*) The practical study of Natural Science.

   (*b*) The protection of species requiring protection, and the circulation of information which may dispel prejudices leading to their destruction.

   (*c*) The publication of papers on Natural History contributed to the Society, especially such as relate to the County of Norfolk.

   (*d*) The encouragement of intercourse between local naturalists by means of meetings for the reading and discussion of papers and for the exhibition of specimens ; and by excursions.

SECTION II.—Members

1. The Society shall consist of two classes of members, viz., Ordinary and Honorary Members.

2. Candidates for membership may be proposed and elected at any meeting of the Society ; three dissentient votes shall exclude the candidate.

3. Ladies or gentlemen distinguished for their attainments in Natural Science, or who have rendered valuable services to the Society, may be nominated by the Committee as Honorary Members, and elected by show of hands at the next meeting of the Society, and shall have all the privileges of Ordinary Members.

4. Every member shall receive notice of his or her election from the Secretary, and shall be supplied with a copy of the Laws, and a syllabus of meetings for each year. A copy of the Transactions for the current year will be supplied on Publication.

5. Ordinary Members shall pay a subscription of fifteen shillings per annum. This may be compounded for by a single payment of £12. All members of a family may become Ordinary Members on payment of an annual subscription of 25s. Schools may cover the cost of membership for any six pupils on payment of two guineas.

   All subscriptions shall be payable in advance, the first being due on election and subsequently at the beginning of each financial year, Members elected after December shall not be liable for the subscription for the financial year in which they are elected. All members whose subscription shall be two years in arrear, and who shall neglect to pay the same on a second application from the Treasurer, shall cease to be members.

6. The financial year shall end on March 31st ; and subscriptions for the ensuing year shall become due forthwith.

7. Any member who, in the opinion of the Committee, contravenes the objects of the Society, is liable to have his or her name erased from the list of members.

SECTION III—Officers and Management

1. The Management of the Society shall be in the hands of the Committee.

2. The Committee (three of whom shall form a quorum) shall consist of the officers of the Society, together with nine members, three of whom shall be elected annually for a period of three years. The retiring members shall not be eligible for re-election until after the lapse of one year, but, should any vacancies occur sooner, they shall be eligible for filling up such vacancies.

3. The Officers of the Society shall be a President, President-elect, Vice-Presidents, Secretary, Excursions Secretary, Treasurer, Auditor and Editor, all to be elected by show of hands yearly at the Annual Meeting and all to be eligible for re-election.

4. The Committee shall prepare a list of the names of members they recommend to serve in the offices which will become vacant at the Annual Meeting, and such names shall be sent to each member with the circular calling the meeting ; any member shall be at liberty to propose other names.

5. The Committee shall have power to enact such bye-laws as they may deem necessary, which bye-laws shall have the full force of laws until the ensuing Annual Meeting. The Committee shall take such other steps and make such appointments as they may deem advisable for the benefit of the Society. All such actions shall be submitted for confirmation at the next Annual Meeting.

6. A special meeting of the Committee shall be called at any time by the Secretary, on receiving a written requisition signed by any five members of the Society.

SECTION IV—Publications

1. The Society shall sponsor an annual publication under the title of "The Transactions of the Norfolk and Norwich Naturalists' Society." Responsibility for this publication shall be vested in an Editor and Sub-Editor.

SECTION V—Meetings

1. The Annual Meeting for the election of Officers for the ensuing year shall be held in April, when the Committee shall submit a Financial statement and Report of the year's work. Any Law, or alteration, or repeal of existing Laws, passed at the Annual Meeting, shall at once come into operation.

2. The President on receiving a request in writing signed by not less than seven members shall, within fourteen days from the receipt thereof, summon a Special General Meeting of all members of the Society ; at the same time giving them due notice of the agenda ; and the meeting so summoned shall have the same powers of altering and dealing with the constitution, laws, funds and property of the Society, as the Annual Meeting.

SECTION VI—Property

1. The property of the Society, other than invested funds, shall be held in trust by the Treasurer for the time being. Accumulated funds shall, at the discretion of the Committee, be invested in the names of two joint Trustees, to be appointed at an Annual or Special General Meeting.

Note.—Information concerning the Library can be obtained from the Hon. Secretary.

NORFOLK AND NORWICH NATURALISTS' SOCIETY.

BALANCE SHEET

As at 31st March, 1952 and 1953

LIABILITIES

	1952 £ s. d.	1953 £ s. d.
Amalgamated Funds	714 11 0	577 1 0
Add Surplus this year	—	83 12 11
Less Deficit this year	137 10 0	—
	577 1 0	660 13 11
Subscriptions in advance	17 10 0	73 0 0
Barclays Bank	196 7 0	—
Sundry Creditors	20 7 7	272 3 6
	£811 5 7	£1005 17 5

ASSETS

	1952 £ s. d.	1953 £ s. d.
Subscriptions due	43 0 0	—
Investments (4)	723 5 5	723 5 5
East Anglian Trustee Savings Bank (5)	16 0 2	216 8 2
Office Equipment at cost	37 6 2	37 6 2
Less Aggregate depreciation to date	22 6 2	27 6 2
	15 0 0	10 0 0
Barclays Bank	—	23 6 1
Sundry Debtors	14 0 0	32 17 9
	£811 5 7	£1005 17 5

Income and Expenditure Account

For the Years ended 31st March, 1952 and 1953

	£ s. d.	£ s. d.
Cost of Transactions	230 17 6	219 9 0
General Expenses :		
Postage, Printing and Stationery	31 10 3	78 4 1
Library Rent	6 5 0	6 5 0
Cost of Lectures and Excursions	17 8 9	16 16 0
Subscription to Scientific Society	3 17 6	2 17 6
Norfolk Naturalists' Trust	—	—
Norfolk Research Committee	5 0 0	—
Sundries	5 17 4	5 11 4
Depreciation	5 0 0	5 0 0
Special Events :		
Annual Dinner	—	—
Tea Party	—	—
Festival Exhibition—Norwich Castle Museum	51 17 0	—
Surplus for the year	—	83 12 11
	£357 13 4	£417 15 10

	£ s. d.	£ s. d.
Subscriptions :		
Annual	180 17 6	301 4 0
Life	8 0 0	36 0 0
	188 17 6	337 4 0
Sale of Publications	1 10 10	1 4 3
Interest and Dividends	29 15 0	24 18 0
Sundry Receipts	—	1 13 0
Special Events :		
Garden Fete	—	40 14 1
President's Public Lecture	—	12 2 6
Peter Scott Lecture	—	—
Deficit for the year	137 10 0	—
	£357 13 4	£417 15 10

Audited and found correct,

H. RILEY,

Hon. Auditor.

I

SECRETARY'S REPORT, 1952–53

ORDINARY meetings of the Society were held at Norwich Castle Museum (except where otherwise stated) as follows:

1952

OCTOBER 18TH. Mr. A. Leutscher, B.SC., F.Z.S., of the British Herpetological Society, gave a most interesting account of the six species of British reptiles and illustrated his lecture with specimens and slides. The Misses A. M. Davies, N. E. Ireland, J.P., E. Forsythe and I. M. N. Cresswell, Messrs. W. G. Bailey, P. R. Page, J. S. R. Pankhurst and P. Stroud and Lord Amherst of Hackney were elected members of the Society.

NOVEMBER 11TH. Mr. R. P. Bagnall-Oakeley gave a Public Lecture at the Stuart Hall, Norwich, on "Rare Birds in Norfolk," illustrated with his own colour films taken at Cley, Holkham Park and on the Broads.

NOVEMBER 15TH. The President gave a delightful account of a journey through England from a southern county to the Farne Islands and of the flora and fauna of the Farnes, with special reference to the bird life and the local colony of Atlantic seals. A series of coloured slides and a colour film added considerably to the afternoon's enjoyment. At this meeting it was announced that Her Majesty the Queen had graciously granted her patronage to the Society. Mrs. E. M. Brooks, Mrs. J. E. Gurney, Mrs. R. B. Hayes, Miss E. Hayes, Miss J. Bush, Miss S. Woolley, Miss J. Wheeler and Messrs. I. Brett, C. Hill and M. Sendall were elected members. Under the new School Affiliation Scheme, the following schools were registered for membership: Town Close School, Notre Dame School and The Blyth School.

DECEMBER 13TH. A "Country Questions" programme arranged by the Hon. Secretary proved of considerable interest. The team, which dealt ably with fifteen widely diverse questions, consisted of the President, Mr. W. E. H. Fiddian, Mr. H. J. Howard and Mr. J. E. Sainty. The following new members were elected: Mrs. E. Orgill, Mrs. G. Mason, Dr. and Mrs. J. C. Johnston, Miss G. Armitage, Miss M. S. Dunbar, Miss E. M. V.

Fletcher, Miss A. E. George, Mr. R. H. Gardner and Mr. R. I. Hook. The City of Norwich School was accepted under the School Affiliation Scheme.

1953

January 3rd. Mr. Ian Hepburn spoke on "Coastland Plants," illustrating the ecological features and specialised vegetation of the coast by means of a fine series of coloured lantern slides. The following new members were elected: Dr. Susan Palmer, Miss G. Beeson, Rev. A. Prescott and Messrs. P. J. K. Edmonds, R. Gray, Roland Green, F. T. Braybrooks, A. P. Baggs, A. Dady, A. Gordon and R. G. Thurrell.

February 14th. In the unavoidable absence of Mr. John Markham, the President gave a running commentary on a series of Mr. Markham's film strips of British Mammals. The following new members were elected: Miss M. A. Bidwell, Miss S. M. Barmby, Miss M. Pennington, Miss E. Nichols, Messrs. K. E. Cotton, J. H. Brummage, K. Lawrence, A. G. Heawood, A. B. Levell and Charles Green.

March 3rd. Miss Frances Pitt gave a public lecture on "Wild Life in Norway" at the Stuart Hall, showing colour films to illustrate her Scandinavian journey. Afterwards, Miss Pitt showed films of some of her special pets.

March 14th. The President gave his Presidential Address, entitled "Recording Nature with a Camera," tracing the progress of photography applied to Natural History and reviewing the methods and equipment used. The following new members were elected: Mr. and Mrs. G. Nicholls, Miss G. E. Read, Miss C. E. Lewin, Miss E. Gayford, Mr. R. Rae, The King Edward VI School, Norwich, and Rockland St. Mary School.

April 18th. The 84th Annual Meeting was held at Norwich Castle Museum, when the following officers were elected: President (for two years), Mr. E. A. Ellis; Vice-Presidents, as before, with the addition of Mr. J. E. Sainty; Hon. Secretary, Mr. F. J. Taylor Page; Hon. Excursions Secretary, Miss R. M. Barnes; Hon. Treasurer, Mr. D. A. Pearce Gould; Hon. Auditor, Mr. C. E. J. Moore; Hon. Editor, Mr. E. A. Ellis. Messrs. R. P. Bagnall-Oakeley, E. Q. Bitton and W. E. H. Fiddian were

elected to serve on the Committee for three years in the places of those retiring by rotation and Mr. E. T. Daniels for one year in the place of a member retiring prematurely. The Hon. Treasurer's report was accepted. The retiring President, Mr. R. P. Bagnall-Oakeley, referred to the additional activities planned for the Society in the near future, including a Biological Survey of one of the Bure tributaries, a joint excursion with the Suffolk Naturalists' Society, an Annual Dinner and an Annual Christmas Lecture. The Hon. Secretary reported that the Society's membership was the largest in its history. It was proposed to ask all members to record their special interests and to arrange for specialist group meetings to be held from time to time in addition to the ordinary general meetings. At the conclusion of the business meeting members were entertained to tea and went on to view the Annual Exhibition which had been staged in the Museum Lecture Room.

F. J. T. P.

Report on excursions held by the Norfolk & Norwich Naturalists' Society in 1952.

May 15th. About 40 members and friends were shown the cliff formation at West Runton by Mr. J. E. Sainty. The fulmars were seen at their nesting site. Some members did some shore collecting.

June 8th. 20 members were shown the woodlands at Melton Constable Park by Mr. T. W. Irvine, who explained forestry methods. Deer were seen in the park and bird and plant life of the lake provided additional interest.

June 26th. The excursion to Walberswick was cancelled for lack of support (Norfolk Show week).

July 13th. 28 members travelled in cars to Scarning Fen and Foulden Common, where, under the guidance of Mr. K. C. Durrant and Mr. E. Q. Bitton, many interesting plants were seen and listed. Tea at the George Hotel, Swaffham.

July 20th. About 30 members visited Scolt Head Island to study plants, birds and insects of the dunes and salt marshes.

July 26th. About 20 members explored Holt Lows under the guidance of Mr. P. H. Simon. The rich flora of bog and heathland was seen at its best.

August 14th. About 15 members visited Alderfen Broad and Heron's Carr, Barton Broad in the afternoon.

September 10th. About 20 members explored Buxton Heath, Hevingham.

October 19th. 18 members took part in a fungus foray at Wheatfen Broad, Surlingham. Specimens were named and laid out for inspection at the end of the foray.

Ruth M. Barnes,
Excursions Secretary.

THE "TRANSACTIONS."

Note by The Editor.

With the issue of this Part, which completes Volume XVII, the traditional character of the *Transactions* is maintained but for the exclusion of a Bird Report, which was issued jointly with the Norfolk Naturalists' Trust earlier in the year. In future, the *Transactions* will be published in special sections, viz., Botany, Freshwater and Marine Biology, Entomology and allied subjects, Mammals, Reptiles and Amphibians, and Geology (embracing Topography and Palaeontology), in addition to an annual Bird Report for Norfolk. The first Part of the new series will include a short *Flora* of Norfolk.

The Society holds a limited stock of back numbers of *Transactions* and enquiries concerning these should be made through Miss D. M. Easter, 99, City Road, Norwich. The price of all parts of Volume XVII is 10s. 6d.; all earlier parts are available at 2s. 6d. each.

II

PRESIDENT'S ADDRESS

Digest of a commentary on films and slides in colour given by R. P. Bagnall-Oakeley to members of the Norfolk and Norwich Naturalists' Society at the Assembly House, Norwich, on 14th March, 1953.

RECORDING NATURE WITH THE CAMERA.

It is difficult to say when nature photography first began but it was certainly less than eighty years ago. Though it is true that a few pictures of nature subjects had appeared before 1873 they were not the work of photographers whose interests were directed towards natural history, but chance exposures of subjects which attracted their attention and happened to have a natural history flavour about them.

Probably the factor which militated most against the production of nature pictures was the use of the wet plate as the only form of sensitised emulsion in the early days. Apart from this almost insuperable drawback for work in the field, the size and weight of photographic equipment was considerable. Moreover the " speed " of photographic emulsions was very slow by later standards and this limited subjects to stationary objects such as flowers, nests and the occasional bird incubating eggs.

The impetus given to nature photography by the introduction of the dry plate was not as rapid as would have been expected, for now no place was too remote for the energetic enthusiast.

Apparatus was, of course, still heavy and cumbersome but a supply of plates could now be transported anywhere, from the sea shore to the remote fastnesses of mountain crags and peaks.

It is probable that the first man to photograph wild birds in Britain was R. B. Lodge, who although a professional portrait photographer was one of the pioneers of the recording of wild life with the camera. It is not my intention to trace in detail the history of nature photography which would necessitate the consideration of the work of numerous photographers from the earlier pioneers to the outstanding members of the host of present day workers, many of whom have achieved a standard of

technical excellence which is almost beyond criticism. I shall therefore mention only a few names and endeavour to select factors which have most markedly contributed to nature photography as it is to-day.

No mention of the early photographers would be complete without the names of the Kearton brothers—Cherry and Richard—whose tireless energy and constant experiment were potent factors in the advance of photographic technique in the field and whose books—the first on nature ever to be illustrated wholly by photographs—opened the eyes of so many people to possibilities of this relatively new medium for recording nature.

As yet, the use of hides for the concealment of the photographer and his apparatus were not used and most of the pictures of wild creatures were stalked shots. King and Heatherley were busy stalking sea birds the former using his famous black cloth under which he successfully approached so many of the birds of his island home, probably without realising the significance of the comparatively recent discovery that birds recognise their fellow creatures by the nature of the solid outline, which he was concealing. I shall refer to this important factor in stalking later on. Even those photographers who concealed their persons by a covering of canvas or sacking had not yet realised that much larger hides could have been used to screen from view not only themselves, but also their apparatus.

The Keartons were the first to try using hides, but they believed that these must be imitations of natural objects inside which they could operate the camera. And so the well-remembered hollow ox from which a nesting lapwing was photographed followed an earlier hide in a dummy tree trunk. Only gradually was the normal photographic hide of to-day coming into use, largely because of the extreme reluctance of these early naturalists to risk making their subjects desert their nests. Even now there is much to be learnt about hides and their uses, especially when the birds to be photographed are away from the nest and on passage. But more of this subject later.

The appearance of the reflex camera marked the next great step forward in the photographers' equipment. The old field cameras and the tripods which supported them were masterpieces of craftsmanship in wood and brass, but apart from being bulky, they had the great drawback of having to be focussed

under a dark cloth on a ground glass screen at the back of the instrument, which had then to be replaced by the dark slide containing the plate, before an exposure could be made. The new reflex principle relied on focussing by means of a mirror reflecting the image into a screen on the top of the camera, while the plate with its slide withdrawn awaited exposure behind the focal plane shutter. The subject could be watched and focussed in the screen until the moment before releasing the shutter, when the mirror was raised and the picture taken. But still there was little reduction in the weight and bulk of the photographers' apparatus and huge loads had to be dragged up hills and carried over heath and bog, saltmarsh and mudflat.

All the while that the advance in camera design was occurring, the speed of photographic emulsions was improving and their " grain " getting smaller. Both of these were important factors, for movement was becoming less of a limiting factor and degree of enlargement of pictures could be increased without producing too much of the " dottiness " of newspaper reproductions.

Even by 1910 some splendid pictures had been produced. B. B. Macpherson had published his very comprehensive series of studies of golden eagles, Riley Fortune, Oliver Pike, Bentley Beetham and others had made names for themselves and even the women were well to the fore. Miss E. L. Turner, Miss Frances Pitt and that great traveller Miss Haviland were already well known names, the former being the probable originator of what she herself called " Wait and See " photography. This was the process of erecting a hide at a selected spot where for one reason or another birds came, and chancing your luck.

Though, by now, hides were in general use many photographers were still using great ingenuity to get on terms with their subjects without using them. Remotely controlled cameras operated electrically or with wire or thread were often yielding good results. All kinds of incredible home-made apparatus were produced and the principle of the trip-wire contact was being used on all kinds of creatures from voles, by the Keartons to elephants by Radcliffe Dugmore.

By 1914 further improvements in the photographers' equipment were on the way. Smaller and more compact cameras using roll films as well as plates had appeared and wider

aperture and longer focus lenses of better quality were also available. Even to-day many photographers continue to adhere to the larger reflex cameras, but the noisy roller-blind shutters have given way to silent " luc " type. The use of open flash and later of flash bulbs opened up new fields for photographic exploitation, particularly nocturnal mammals, which up to this time had defied almost all attempts to record them in pictures. Here the automatic trip-wire which fired the flash and operated the shutter simultaneously was a fertile means of producing photographs. This branch of photography had few more energetic and resourceful exponents than H. Mortimer Batten.

Still the speed of photographic emulsions increased and still the apertures of lenses got larger, while further improvement of lens speeds has quite recently been accomplished by the process of blooming.

By the middle 1930's colour plates and films both for still and ciné cameras had improved sufficiently in speed and colour quality to attract several of the already established black and white photographers But these colour emulsions had very little latitude, so more accurate exposure meters were demanded to reduce the margin of error to a minimum. The old visual meters and calculators though not entirely displaced even to-day, gave way to the versions employing the photo-electric cell especially with workers in colour, who could not afford to make mistakes. Afford is an apt word, for colour sensitive emulsions were—and still are—very expensive. For the amateur, colour transparencies produced by a " reversal " development process give the only satisfactory colour rendering, though several makes of colour films that produce negatives from which either black and white or colour prints may be made, are on the market. Unfortunately, the equipment for colour printing these is not yet available and professional results are expensive and often far from good, since the colour quality is dependent on the opinions of the processor as to what the subject should look like.

At the present day hosts of nature photographers are record- all kinds of subjects from big game to diminutive fungi.

The improved quality of colour transparencies in spite of the slow speed of the emulsion was attracting increasing numbers of

photographers who had now a new and accurate way of recording botanical and mycological specimens without collecting them. The essential details of date, place and special circumstances could all be noted and the resulting transparency became a record in the form of a slide. In some cases colour negatives were produced and the records were pictures with data entered on the reverse side.

In the early 1940's the appearance of the strobotron tube—a means of producing a flash of intense brilliance and very short duration—heralded one of the greatest advances in nature photography in the whole of its short history. By synchronising the camera shutter with the flash, so that it came during the relatively short period in which the shutter was fully open, exposures could be made in dull light or darkness. The most important factor, however, was the tremendous speed of the exposure—from one five thousandth of a second to twice or even three times that speed being obtainable. The apparatus which could produce this remarkable result was made portable and could be operated in the field under reasonably dry conditions. As with so many new inventions High Speed Flash was used at first to obtain only spectacular results, and though the full possibilities of the new apparatus may have been realised by a few workers or, more probably, by a few people who did not possess an outfit, it was not for two or three years that we began to see many of the special advantages of this revolutionary advance fully exploited. The early H.S.F. pictures were mostly of birds in flight, and some remarkable photographs which "froze" the action of the subject and obtained needle-sharp definition were taken. A new interest was aroused in the mechanics and aero-dynamics of bird flight as picture after picture of birds in all kinds of attitudes, and with every sort of bend and twist on the flight feathers and tail, was published. Moreover, the majority of these photographs were of nocturnal birds—owls, nightjars and others—returning to their young with food. Such was the clarity of definition that the prey could be identified with certainty in most cases ; a factor contributing to accuracy of ornithological knowledge.

In H.S.F., too, there was a new medium for recording nocturnal mammals, many of the smaller of which had been more or less completely neglected photographically except in

captivity. Moreover, in normal weather conditions mammals are more easily attracted with bait than birds, since the majority hunt largely by scent. However, there were other nocturnal subjects than mammals and birds to which the new technique could be applied. Pictures of snails, slugs and even cockroaches appeared, not that the first two of these required the speed of flash to " stop " their movement : it was simply the easiest way of taking their photographs.

Bats provided another obvious subject for flash, especially since their means of ingress and egress to their roosts could be restricted if necessary, thus making them pass through small apertures. The relatively prescribed hunting areas of some species also gave chances of exposures, though good results were much more difficult to obtain.

Gradually the cult of H.S.F. increased the number of its adherents as the apparatus became safer (the early ones could produce severe electric shocks when damp), more portable and cheaper, and all the time new designs were being contrived to give more and more brilliant flashes with two or more flash units from each set. Other refinements were added such as a ray device on the on principle of the burglar alarm, which the bird operated as it crossed the beam, thereby taking its own picture. Perhaps no single photographer did more to popularise H.S.F. than Eric Hosking, whose book " Birds in Action " showed what could be done, with skill, ingenuity and patience. His studies of various of the smaller passerines attacking stuffed cuckoos placed in the vicinity of their nests are now famous, while his flying shots of birds captured in ringing traps and released through a cardboard cylinder are almost equally well-known.

Still the quality of apparatus and number of refinements and accessories increases, the speed of sensitised material and quality of colour plates and films improves, and the number of nature photographers mounts steadily.

My own photographic career began at the age of fourteen when I was given a reflex camera and the necessary apparatus to process my own plates and make my own prints. I learnt my early lessons the hard way—by making mistakes and learning from them : and learning all the more thoroughly by having to find the majority of my working materials from my own pocket

PHOTO. I. Typical hide for migrant waders; small and well camouflaged.

PHOTO. II. Dunlins, Cley, August, 1952.

PHOTO. III. Red-necked Phalarope, Binham, November, 1954.

PHOTO. IV. Kittiwakes, Farne Islands, April, 1952.

PHOTO. V. Grey Phalarope, Cley, October, 1952.

PHOTO. VI. Glaucous Gull, Seahouses, Northumberland, April, 1952.

PHOTO. VII. Bird's Nest Orchids (*Neottia nidus-avis*), Holt Woods, June, 1953.

PHOTO. VIII. Waxwing, Cley, January, 1951.

money. From caterpillars, I graduated to flowers and then to garden birds, though I hardly took a presentable bird photograph until I had left school. At the university and later as a schoolmaster living on the North Norfolk coast, I developed an addiction to wildfowling, which became almost a mania. In the nesting season I continued to photograph birds, but in the winter the camera was discarded for the gun, except for pictorial work mostly landscapes.

It was probably this wildfowling experience which determined the nature of my later photography. Eight or ten years of striving to get on terms with the wildest of all birds—the ducks, geese and waders—and the views of these at relatively close quarters after a successful stalk, decided me to give up the gun for the ciné camera and my periods of operation changed from dusk and dawn to the lighter hours of the day. The quarry remained the same, but the shots produced permanent records in colour as well as black and white. Moreover they give pleasure to hosts of other ornithologists who are unlucky enough not to live near that unrivalled part of the British Isles for passage migrants—the North Norfolk Coast.

The rest of what I have to say concerns the methods employed in order to come to photographic grips with birds away from the nest. The following observations are the results of my own experience and may well be different from the findings of others. Discussions with other bird watchers leads me to believe that there are numerous ways of getting close to birds and these may differ with conditions and species.

The chief attraction for most birds to any particular vicinity is food. This is especially obvious in the case of berry-eating birds in hard weather, but all species may be observed to return again and again to the same feeding grounds so long as the food supply lasts. Among the waders certain individuals or small groups of birds can be seen to have definite preferences for particular pools, and usually have a limited number of other places to which they go when flushed. It is important to observe the departure of the birds from a pool where a hide has been prepared so that an assistant—an indispensable ally—may put them back to the photographer after a suitable lapse of time.

A second attraction for birds, especially when they want to rest, is shelter. Pools in the lee of high banks or in the quiet

seclusion of the reed beds, regularly draw a variety of waders and duck which come in to rest and bathe.

Seed-eating birds and scavengers can often be " baited " to a selected spot. In this way I have lured such otherwise elusive species as Lapland Buntings, Shore Larks and Glaucous Gulls.

The driving of birds up to a hide or even an unconcealed photographer can frequently be accomplished by an experienced beater, though in the case of many species such as snow-buntings and the finches it is often better to set up the camera ahead of the obversed direction of feeding, and let the birds approach of their own accord. One definite warning—the result of bitter experience on more than one occasion—never attempt to sandwich a bird or group of individuals between the beaters and the camera, if the latter is less than 40 yards or so from the former. No bird however tame, will tolerate being confined in a smaller and smaller space between two unknowns, probably both suspected enemies. It will always " run out " or fly. It is surprising how vigorous movement at a distance will serve to guide and keep a bird moving towards a hide or even an unconcealed photographer. Driving the photographer's quarry up to hides should always be a slow process, however far the distance to be covered may be, owing to tendency for the birds to maintain the fast speed of the early part of a drive, and thus give the photographer very little chance for making exposures. The general tendency of most birds to " drift " slowly away from relatively distant people is the best characteristic to exploit.

Another form of driving birds up to a concealed position is that of using the incoming tide. This is easiest on large estuaries where well raised islands or promontories have become accepted resting places between the ebbs. Such is the famous Hilbre Island in the estuary of the Cheshire Dee. However the tidal flats of the East Coast have few suitable places for such work though carefully selected shore positions may yield results.

The drastic restrictions of feeding areas for water birds and waders in very hard weather and the resulting tameness of hungry photographic subjects, may be used to great advantage. The winter light is poor in quality, but bright days in snowy

weather may give good opportunities for both colour and still photography. Open sites, are however, essential for colour work. Seed-eating birds are compelled to forage among the standing plants since the fallen seeds are snow-covered. Thistles, burdocks, orache and other plants are worked over again and again. Thrushes, blackbirds, redwings and fieldfares may be attracted by raking out hedge bottoms after clearing away the snow, especially if berries are scattered on the exposed ground. Scavengers are quick to locate carrion on the surface of the snow, though they are usually very wary and suspicious of all but the most camouflaged hides.

Another productive method of obtaining pictures is stalking, though this requires practice and complete disregard for personal comfort. It is seldom possible to get really close to duck and waders which tend to feed in the open without being seen, but it is surprising how often a human figure in a completely prone position is disregarded or treated with indifference provided movement is slow. The human face should always be masked by some dark-coloured material—a fact well known to serious pigeon-shooters—while a most important point to remember is that birds recognise their enemies as much by outline and solid shape as by any other characteristic. Thus, if the completely prone position is precluded by the nature of the ground, it is essential to adopt some kind of headgear which fills in the tell-tale gap between the shoulders and the head, so as to mask the most characteristic feature of the human form. Where there is a certain amount of cover in the way of bushes, large tufts of grass or clumps of plants, a small screen may be made behind which the stalker may move, but the old adage which has appeared for so many years in military manuals of fieldcraft ; " A bush moving across an open space is bound to attract attention " ! must be heeded, since movement should be very slow.

The photography of birds in flight requires abundant practice especially with long focus lenses on a ciné camera. Specially adapted instruments fitted with a gun-type stock and pistol-grip control are a great help in swinging the camera steadily, and holding the subject in frame but these are by no means essential. Long continued practice without a film in the camera is easy to obtain and is the only means of yielding good results,

especially if the bird to be filmed is a fast-moving, quick-turning species like the swallows or flycatchers. When the light allows, slow motion ; i.e. exposing at a large number of frames per second and projecting the result at normal speed, will produce effective results, especially if the purpose of the film is to reveal recognition features or show the movements of flight.

Finally the question of hides for " away from the nest photography " is important. Few passage migrants will tolerate the sudden appearance of a rectangular hessian or canvas tent at their feeding grounds. Preparation for the erection of a small hide should be made by introducing a pile of cut reeds or some such harmless looking mass of natural material, which may be added to day by day until a hide can be concealed within or camouflaged with some of it. It is always a good idea to have a screen of reeds held loosely in position round the sides and part of the front of the hide. These can be secured with gardeners' bamboos and string, but should be carefully fixed to prevent obscuring the field of operations. They should have the leaves attached and stand about six inches clear of the sides, when the slightest breeze will cause sufficient movement and sound to mask any noises from within, while the broken shadow-pattern helps to make the sunward side less conspicuous. Permanent hides of a more rigid construction are, of course, better still, but too many of these would have to be put up if most of the " likely " spots are to be covered. However, a few of these at specially favoured pools and other feeding or resting sites can save a great deal of time and trouble since they soon become an accepted part of the landscape which the resident birds disregard, as being harmless. Migrants seem to consider them as an integral part of the countryside and provided there is not too much coming and going from them, they can be exceedingly productive of photographs and films. Portable dummy hides can also be used to advantage to get birds used to such structures. These can be moved and finally replaced by the real thing. One last kind of hide which is often extremely successful is a car. Ideally, something of the Land Rover type with station-waggon body which can get over a variety of country, is employed. I am told by experienced adherents to this technique, that a driver who can steer backwards by using the mirror, while the photographer operates

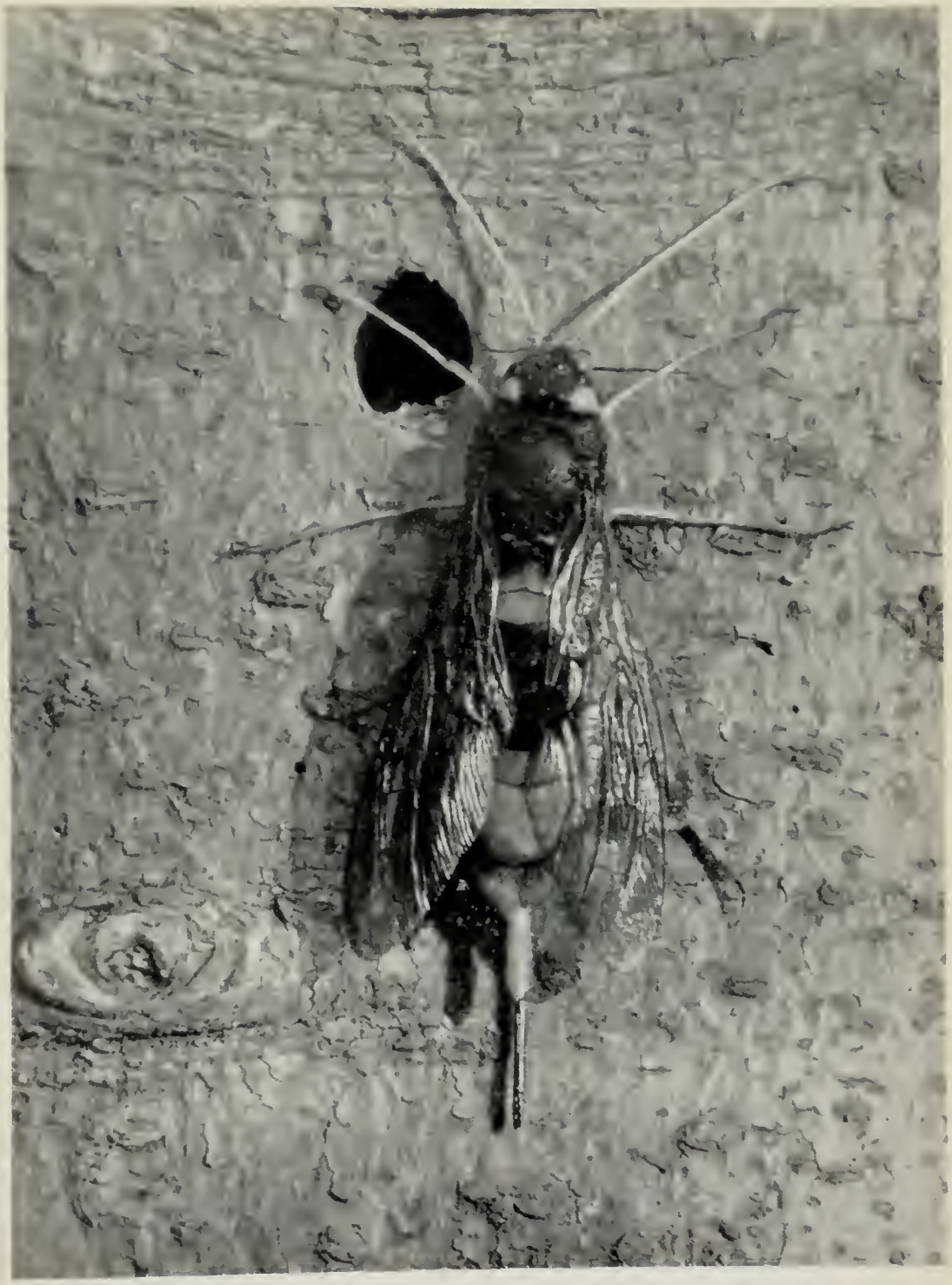


PHOTO. IX. Greater Horntail (*Urocerus gigas*), Brinton, July, 1952.

PHOTO. X. Death's-head Moth (*Acherontia atropos*), 1952.

from the back, is a valuable asset. The windows should, of course, be screened with hessian or some such material. I have myself taken many pictures at roadside pools, streams and bushes, though I have not tried the pursuit of birds in a backward moving vehicle over plough and heatherland.

No nature photographer should forget that any subjects which appear to be of special interest even if not in his own province, are worth an exposure since they may be of great interest to others and form a valuable record if the normal data concerning them are noted.

III

THE WILD DEER OF EAST ANGLIA.

By F. J. Taylor Page.

The decline in the mammal population in Norfolk and Suffolk during historical times is largely attributable to deforestation. Vast areas that once provided shelter and food for many species no longer recorded in our native fauna, gradually ceased to do so. Driven by hunting, such species sought a last refuge in the fens, where they finally perished. Evidences of this have from time to time been discovered. Abundant remains of red deer and, less frequently, roe deer, occur with bones of bear and beaver.

Whilst conditions since the time of their normal incidence have certainly not encouraged a return of the larger carnivores, just a few of the post-glacial mammals whose existence might have remained forever one of historical interest, have once again been able to establish themselves with the help of Man. Four species of deer, by direct introduction as occupants of recent woodlands, as escapes from deer-parks, or as outliers from stag-hunting, can now be included in our East Anglian fauna. Two of these, the roe and the red deer, are truly indigenous. Of fallow deer it can only be said that closely-related species inhabited Great Britain in warm inter-glacial periods, that no trace of true fallow has been found in peat or other deposit so far examined, and that fragments of antler of these creatures have not been found earlier than in refuse heaps associated with the Roman occupation. This has been taken to indicate that fallow were introduced as food, probably from Greece or Portugal where they had retained a hold. Our fourth deer is of very recent occurrence, having suddenly appeared on at least three occasions at widely different places. This newcomer, the Muntjac or Indian Barking deer, never existed as a member of the British fauna of the past. It was first introduced at Woburn in Bedfordshire during the nineteenth century. A number of escapes occurred, and their appearance on the eastern side of England suggests that they are quite well able to wander widely and look after themselves.

Roe deer (*Capreolus capreolus*) were introduced first in North West Suffolk by Sir William D. Mackenzie about the year 1884. Writing to his friend Mr. Heatley Noble, the entomologist, he says, " Roe obtained from Wurtemburg and turned down in the young Warren woods have increased considerably." The original six pairs were at first kept in a deer pen at the corner of what was then called Great Queen's Wood, below the lodge on the Thetford-Brandon road, an area of some three hundred acres which later became their home. In the thickly-wooded Downham estate they had every chance to breed and spread farther afield. Some migrated southwards through High Lodge to the Elveden estate, and records in 1903 show that they had reached West Stow, Icklingham, Livermere and Euston, some fifteen miles from their starting point.

By crossing the river below Santon Downham, they began to populate Norfolk about the year 1900, spreading from Two Mile Bottom across what is now Santon Street to the Drove Road and Grimes Graves. There they could frequently be seen in the evening feeding openly on the breck. Stragglers penetrated still farther towards Mundford, High Ash, Cranwich and Didlington. Even before 1919 they were regularly trapped and snared but despite this they increased, and it is somewhat remarkable that so little notice was taken of them by naturalists. By 1921 a peak population appears to have been reached. Keepering of the old estates was declining, and in the thick older woodlands then little cared for, such as Snake wood at Lynford, they could frequently be seen. Foresters reported quite unusually large numbers together, one even recalling seeing about thirty drinking at one of the forest dew-ponds.

With the taking over of vast Breckland areas by the Forestry Commission in 1922, the hey-day of the roe was to pass. Instructions were given to warreners to control numbers, and from that time twenty or thirty a year have probably been killed, the slaughter being greatest up to 1939. This persecution and constant harassing by forest operations have caused these grand animals to shift their ground more and more both northwards and southwards, and to seek once again shelter in the Fenland in what reed swamps still remain on its borders. From time to time more recently, roe have been seen in the plantations and reed beds near Feltwell and Methwold ; on the Stoke Ferry road

and at Oxborough; and even as far north as Wimbotsham, two miles beyond Downham Market. (K. Durrant, 1951)

General observations of Field Officers of the Forestry Commission suggest that the main trend is now in a north and westerly direction. It is to be expected that ere long Swaffham and Gaywood forests and possibly the Queen's woods at Sandringham will become haunts of a small number of roe. In their southward movement, offshoots from those reported as numerous around Brandon (Sir William Taylor, 1937) had reached the King's Forest and the River Lark near Mildenhall by 1938. By 1947 they were in occupation of marshy areas and dense carr between Tuddenham Fen and Cavenham Heath (A. E. Vine). Their most southern station so far recorded is two miles beyond Herringswell near the Bury-Newmarket road (R. P. Bagnall-Oakeley, 1951).

Fallow deer (*Dama dama*) owe their freedom in our woodlands to the breaking up of large estates, or the lack of upkeep of parklands during the two world wars. More particularly in Suffolk, feral fallow occur sporadically in suitable wooded areas from the western fenlands to the eastern coast. Some of the earliest records come from Henham, where in 1914 part of a parked herd on the Stradbroke estate escaped. Ever since they have lived in the woods around Sotherton and Blyford, with the Halesworth-Southwold road marking the southern limit of their range. Each year at the rutting season, bucks from outlying districts travel to Blyford, and as regularly go away again when the rut ends. Numbers have been controlled in recent years, but there appears to have been no decrease in the herd.

In the Ipswich neighbourhood, escapes from herds in Orwell Park and Wolverstone Park account for records of deer since 1929 at Nacton and Levington (H. E. P. Spencer) and at Belstead and Bentley (H. W. Simpson). The Forestry Commission report (1948) records fallow at Rendlesham and Butley, and they have been seen there quite recently. These last are probably escapes from the herd at Campsea Ashe.

Between 1939 and 1945, during the war-time cultivation of the park at Ickworth, numbers of fallow were able to escape into the hunting country round Bury St. Edmunds. Some are now to be found in Tuddenham Fen ; others occupy woods around

Whepstead, Lawshall, Saxham and Barrow (Maj. T. Wilson). Further north a few still occupy Livermere Thicks near the park. It is possible they are survivors of the herd that were kept on the estate before World War I.

In the Norfolk Breckland, a herd of fallow range the south-eastern forest boundaries north of Thetford. Some control of these had to be made owing to quite extensive damage to the pine woods at Roudham. In the north of the county, occasional records of stragglers have come in the past from Runton and Castle Rising. More recently in March 1954, three white fallow were seen in Gaywood forest near King's Lynn (I. Brett). Their origin is at present unknown.

About 1942, twelve dark fallow escaped from Dudwick Deer paddock ten miles north of Norwich. They spread to wooded areas and heathlands nearby, the remains of what were once extensive forests. In this almost impenetrable area they bred without hindrance until, in 1950, a herd estimated at between twenty-five and thirty existed. As further increase continued, damage was done to local farm crops, and finally steps had to be taken to diminish the numbers. In January 1954, two New Forest Keepers were brought in by the Agricultural Executive, and aided by Lt.-Col. F. E. D. Drake-Briscoe eight deer were disposed of. Even before this, regular deer drives had been held, and it is believed that the herd is now considerably reduced. Those left have dispersed towards Felthorpe, Marsham and Hevingham. The antlers of a number of these show only very slight palmation, giving them heads not unlike those of red deer. This apparently is not uncommon in feral fallow.

Movements of Red Deer (*Cervus elaphus*) are even less certain than those of fallow deer. In 1950, eight to ten outliers from the Norfolk Stag Hunt were known to exist. Two calves were born out, and subsequently records came in from Forestry Commission areas of small groups travelling together. An almost regular west to east movement has been noted now for several years during the early Spring, but its significance is quite unknown. Roe deer sometimes associate with the stags and not only feed with them but travel through the forests with them too. In the younger plantations, the visits of the red deer result in damage, which, whilst it does not usually kill the trees,

is temporarily unsightly and delays their growth. However, in some of the better established parts of the forest such as at West Harling, small herds have made a more permanent home. Once settled, they apparently do little harm and the Commission welcomes them as a natural part of the forest scene.

In Suffolk too, it is only in the past four or five years that notice has been taken of the incidence of red deer. A hind in calf turned up at Heveningham one winter, and produced a young stag in the following Spring. This was shot when about a year old. The hind was then joined by a stag and had calves by him in successive years. The Hon. A. Vanneck tried to preserve them, but owing to damage they caused to forest and crop, control had to be made. The stag was shot this winter (Lord Cranbrook, 1954).

One outlier travelled far westward into Cambridgeshire and was found lying in a field at Fen Ditton by the Cambridgeshire Farmers Harriers. They hunted it back to Stapleford and western Suffolk. About the same time a stag made a dramatic appearance in the streets of Newmarket by night, where it was reported ultimately to have headed southwards. Though there is no certainty that the two incidents are connected, they might well be, and they certainly serve to suggest big-scale movements in this species.

Of the East Anglian deer, the muntjac or " barking deer ' (*Muntiacus muntjak*) is the least known. It is a small animal, about the size of a dog fox, some twenty-one inches at the shoulder. It has a chestnut red pelage, slightly speckled with grey. The antlers are very short, and the upper canine teeth project from the mouth like small tusks. When running the gait is peculiar, the head being held lower than the flanks. Their introduction, so far as is known, does not appear to have been made nearer to us than Bedfordshire, unless a private zoo may have stocked some. Thus, unless we are to assume that they crossed the open fen country, which is unlikely, though not impossible, they have reached us from Hertfordshire where they have been common for some time. As it now transpires that a small deer shot at Parham Wood near Framlingham in Suffolk, and which was at the time identified as a roe deer in 1940, was almost certainly a muntjac (Capt. H. A. D. Walne), it is probable that a few of these creatures have edged their way in and their

presence has remained unnoticed until quite recently. A mystery that remains unexplained is the sudden appearance on July 27th, 1952 of a muntjac near the swing bridge at Lowestoft. It was ultimately captured by Inspector Frank Wood of the R.S.P.C.A., and subsequently released in the vicinity of Dunwich.

In the early summer of 1953, three of these tiny creatures were at large in Santon Forest between the River Ouse and the cross-roads at Lynford (A. Birkitt) and in September last two more were observed near Forestry Commission land at Leiston (*Trans. Suff. Nat. Soc.*, Vol. VIII, p. 177). They are thus undoubtedly filtering out in all directions from Royston their most northerly station in Hertfordshire, and we may expect to hear more of them as they become more regular occupants of our woodlands and forests.

The Japanese deer or Sika (*Cervus nippon*) a small relative of the red deer, has not, so far, travelled in our direction. It is probable that ultimately it may do so, for if it is capable of journeys such as those taken by other deer, we can most certainly look forward to yet a further addition to our fauna ere long.

IV

SHORELINE CHANGES ON THE MARSHLAND COAST OF NORTH NORFOLK, 1951–53*

By J. A. Steers and A. T. Grove

A few notes on the physiographical effects of the sea-flood of January 31st—February 1st, 1953, on the marshland coast of Norfolk may be of interest and also of some value as a record. The details of the coast were mapped in the summer of 1951, and special care was given to the mapping of Scolt Head Island and Blakeney Point in that year and also in 1953, after the floods.

Embankments were breached in several places and all the fresh marshes were flooded. There is no need to discuss here the tragic effects of the flood at Cley, Salthouse and, to a lesser extent, at other places.

Between Hunstanton and Gore Point, dunes were eroded and the sea overwhelmed the ridge protecting Holme Marsh and locally pushed it inwards. The water in the marsh helped, in draining out, to cut back the dunes at Gore Point which also suffered in the storm. A new outlet has been made for the channel draining the Marsh about 150 yards westward of the dunes at the Point ; it will be interesting to see how this will behave.

The dunes between Gore Point and Thornham were not seriously breached. There, as in many other sections of the coast, the lack of any great change is the significant point. The low ridge of sand, with some shingle and shell, which had formed in front of nearly the whole length of these dunes, was flattened and almost obliterated in parts. One gains the impression that it gave some protection to the dunes by causing the waves to expend their energy at the height of the storm.

The crescentic island at Thornham was also somewhat flattened and overswept, especially in its mid-parts. The seaward face may be a little less crescentic, but otherwise its outline is scarcely altered. A ridge running west from the island has developed and may have been enlarged in the storm.

*In 1953 the survey work was carried out by R. J. Small, P. Haggett, M. Chisholm and D. Brearley.

The derelict wall at Titchwell was badly broken and the channel formed by water draining from a breach made in 1949 was much enlarged. Scour has cut the channel well below beach-level, and the old marsh muds exposed on the foreshore have been deeply cut by gullies which extend back into the former reclaimed marshes. The dunes along the golf links were eroded but not seriously.

Scolt Head Island did not suffer badly, but some interesting changes took place. The main line of dunes at Scolt Head (the Hut dunes) were cut back 12 to 15 yards, and Norton Hills at the eastern end of the Island were eroded by a similar amount. The low dunes lying between these two accumulations were covered by the sea and for the most part destroyed. Since, however, they were very low before the storm this is a change, in itself, of little moment. The most obvious effect on the main beach was the break-through just at the west end of Norton Hills when the sea swept through a small breach which already existed and spread a large fan of sand and shingle on the marshes. Although this was not very serious and might well have healed itself, it was agreed to block it artificially. Two lines of metal posts supporting wire fencing have been put in, and it is hoped that they will collect beach sand and in time be buried by new dunes. The breach constituted a limited threat to the sea-walls and the marshes within them, and so it was closed. It is important to appreciate that this is the first major alteration of any kind, other than those by nature, made to the island. As such it must be regretted as the island formed perhaps the best feature of its type in England and Wales. The only other important changes on Scolt Head Island have been at the Far Point and at Beach Point. Far Point usually alters a good deal from year to year and, as shown in Figure 1 the changes were no greater between 1951 and 1953 than they might have been had there been no storm. It is worth noting, however, that a new ridge has appeared in the far north-western end of the Point. At Beach Point the shingle ridge south of Long Hills was completely overridden and pushed eastwards over the marshes, and the dunes at the southern end of Long Hills were seriously eroded.

At the height of the storm the island presented an unfamiliar appearance. Drift-lines make it clear that nearly all the House

Hills area was submerged and, apart from small patches here and there, the only areas of any size appearing above the sea were Long Hills, Hut Hills, the highest part of House Hills, and Norton Hills.

At Burnham Harbour more shingle has accumulated on the north side of the channel. From there to Wells Harbour surprisingly little change took place on the foreshore. The dunes were cut back in places, but rarely for more than 10 yards. Low, fairly new dunes, on the wide beach in front of the Gap, were covered by the flood, but scarcely altered. (They were mapped in 1951.) The same is generally true of the ridges, mainly of sand, near low water mark on the wide foreshore between the Gap and Wells Harbour.

The fresh marshes at Holkham were flooded and many trees damaged by salt-water were killed. Much sand was swept into the marsh through the big gap in the Wells Sea-wall near the life-boat house.

Between Wells and Blakeney again no spectacular changes occurred. Dunes were cut back on Lodge Marsh Island, and the sand and shell ridges off Stiffkey were flattened and spread more widely over the foreshore. Increased scour accompanied the retreat of the flood-water down creeks, but the effects were not sufficient to demand particular comment.

At Blakeney Point considerable changes took place at the far western end ; the ridge of shingle extending south-west from the Headland was straightened out, and the shingle accumulation of Far Point was completely cut off by a channel several yards wide, which, as Figure 2 shows, now runs where once there was a large sand dune. As at Scolt, a new ridge of shingle has been built on the north-west side of the Headland. The life-boat house was flooded and salt-water polluted the water of the well which is normally potable. Most of the lows were flooded and one of the hulks on the Headland was shifted from Beach Way across the creek to Long Hills.

Perhaps the most interesting change in all this stretch of coast occurred on the great shingle bar running from the Headland to Weybourne. Almost throughout its entire length it was rolled inland, for an average distance of about 30 or 40 yards. On the inner edge, where it was washed over the marsh, the shingle edge is locally quite steep. On the seaward side, old

marsh muds have been exposed on the foreshore and lumps of mud have been thrown onto the crest of the ridge by the waves. The ridge as a whole was somewhat lowered, but at and near Cley and Salthouse it has been pushed up again by bull-dozers. This fact is clear enough at present, but in time to come it may be forgotten that artificial raising of the beach was carried out nearly as far west as the Marrams.

A breach about 30 yards wide was made in the ridge off Salthouse and its formation may have assisted in the serious destruction that took place at Salthouse itself. In several places the old cliff lines on the south side of the main road between Cley and Weybourne were attacked by the waves and fresh scars were cut in them. The Wiveton valley was flooded and must have resembled its condition in the great storm of 1897.

Although north Norfolk faced the full force of the storm, the most remarkable point is the small effect it had on the marshlands. We are fully aware in saying this that those who have suffered loss of relatives or of houses, or whose marshes have been flooded, can hardly appreciate this. But we write from the point of view of physical change. The sea expended its power on the beaches, the low dunes and the marshlands which have not been reclaimed. The highest levels were not maintained for long, and consequently erosion of dunes along the tops of beaches was limited. Except where it was impounded by walls, the water soon retreated from the marshes and bad scour holes were not formed. Even the one at Titchwell is insignificant. One must turn to parts of Holland to see the appalling effects of scour. In Schouwen for example, the level of most of the island within the walls was much lower than some of the natural marshes of the Norfolk coast. The island was flooded, breaches could not all be mended even temporarily, and the next tides flowed in and out through them. Hence the breaches were widened and also deepened by successive tides. Some were scoured to more than 100 feet deep, and great gullies cut back far inland from them. This we have been spared and even when the storm cut breaches through the dunes, as in that part of the coast near Palling, the relatively high level of the ground within prevented the devastation which is all too apparent in many parts of Zeeland.

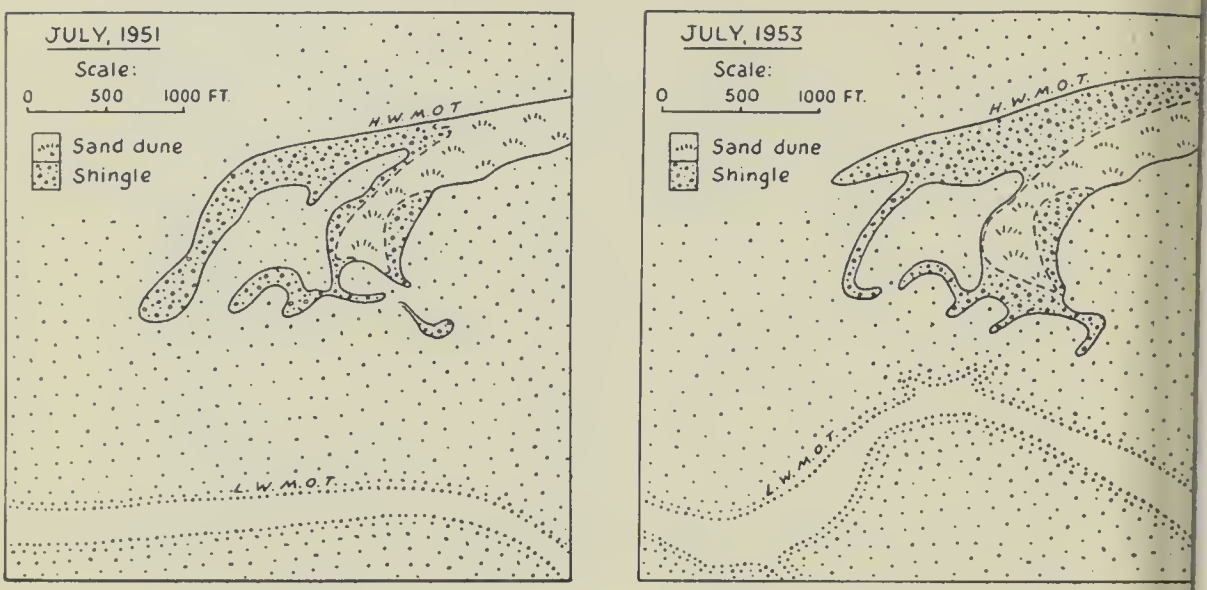


FIG. 1. FAR POINT, SCOLT HEAD ISLAND.

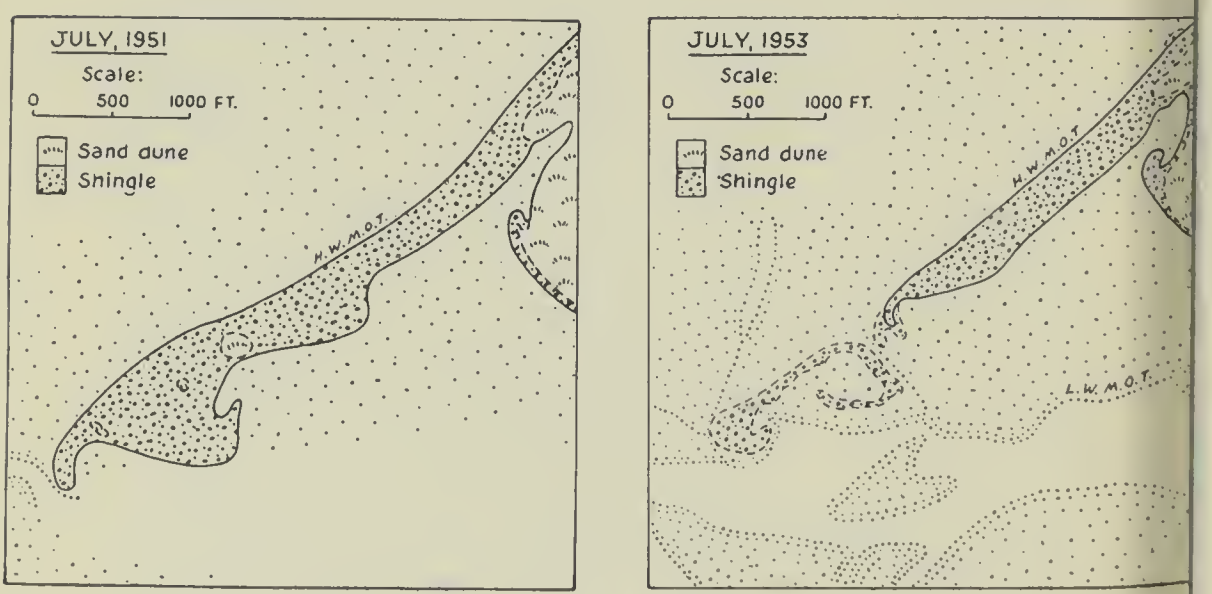


FIG. 2. FAR POINT, BLAKENEY POINT.

V

THE COASTLINE OF FLEGG

From Caister Point to Hemsby Gap, Norfolk

By Charles Green, G. P. Larwood and A. J. Martin

Introduction (Charles Green)

The mask of talus which, in living memory, had shrouded the cliff-face of the Flegg coast, was dramatically flung aside by the " great surge " in the storm of January 31st, 1953. So recently as 1951, the distribution maps in a survey of Norfolk's Pleistocene deposits could show, in this area, only the " line of contact of Great Eastern Chalky Boulder Clay with Great Eastern Jurassic Boulder Clay " (Sainty 1951). But the surge sliced away the talus as though with a knife, leaving clean vertical sections, right down to the beach, for our study. This had need to be done quickly, for the surface began rapidly to weather and, by August 1953, much of it was again covered.

Fortunately, I was able to record some of the exposures at an early date. A fruitful discussion with Mr. D. F. W. Baden-Powell led to more work. My daughter, Mr. D. Kerridge and the two friends who collaborate in this paper, came to my aid and, before it was too late, we made as full a record as was possible in the time at our disposal. My work in Caister had already led me to gather information from the East Norfolk Rivers Catchment Board (now the East Suffolk and Norfolk River Board), who built the Caister sea-wall in 1949–51. The record of their borings and the local records made in 1934 and again in 1943 and 1949, when gales stripped the beach of all sand and exposed its " clay " foundation, have enabled me to complete the tale of major formations from Caister Point in the south to the spot near the Hemsby boundary where the shrinking cliff was, and still is, obscured by sand dunes. From this point the dunes extend to Winterton Ness and beyond ; they have recently been described in these *Transactions* (Steers and Jensen 1952).

It will be seen that our observations provide evidence for the essential continuity of the Pleistocene beds exposed at Corton,

on the " mainland " to the south, and again at Happisburgh, on the " mainland " to the north. Apart, too, from their purely geological value, they throw some light on the status of Flegg as an island in the " great estuary," a subject which is touched on below, but which is to be dealt with more fully elsewhere.

Our thanks are due to Mr. P. E. Rumbelow, Mr. D. Kerridge and Mr. J. Haylett, who have placed a selection of their photographs at our disposal.

Description of the Section (Charles Green)

The gales of April 7th, 1943, and March 1st, 1949, stripped Caister beach of its sand-covering and left exposed a low cliff and beach-foundations of dark brown stiff loam or sandy clay. This clay-loam ended abruptly between Beach Road and the Lifeboat Station, where it disappeared suddenly below deposits of sand (Haylett 1951, Woodhouse 1953). It seems certain that here lay the ancient south-eastern angle of Flegg Island (see below), the sand to the south being the northern end of the water-deposited recent accumulation of the " Yarmouth Spit," to-day covered by dunes. Observations made in 1934 (Ellis 1934) and the borings of the Catchment Board (Cotton 1952) confirm this. It is noticeable, too, that the Ordnance Survey maps give this spot the name " Caister Point," though there is little in its present-day appearance to justify the name.

Northwards from this point, the dark brown clay-loam cliff and its overlying dune-sand are covered by the sloping breastwork which forms the upper part of the Caister sea-wall. Two lengths of the wall, however, are without this breastwork ; one lies just to the north of the " Coastguard Cottages " and the other to the south of Caister Halt (see map). The photograph of the now destroyed Manor House Hotel, which stood over the position of this first gap in the wall, shows the clay-loam as it was exposed in 1935. In 1953, the surge cleared away the overlying debris and it was possible to fix the top level of the clay-loam, which was approximately horizontal at about 15 feet O.D. In the second gap to the north, the dune-sand was cut back several feet farther than the underlying clay-loam, which stood here at about 16 feet O.D. The surface of the clay-loam

was smooth, as though waterworn, and a very thin skin of weathered-out small pebbles lay over it.

North of this second gap, the Railway Co.'s sea-wall covers the face of the low cliff past Dinah's Gap until, at about 1,000 feet to the north, the cliff-top begins to rise above the level of the wall-top. Here the surge came over the wall-top and cut into the cliff behind, revealing a clean waterlain bedded yellow sand with occasional pebble-seams, all capped by a thin dune-layer (see map).

Near the northern end of this wall, the slowly rising strata showed that the yellow sands overlay a stiff chocolate-brown clay-loam. From this point to the Hemsby end of our section, this clay-loam—apart from a doubtful break in the contorted sector—formed the lower part of the cliff above beach-level, the visible base of the cliff during 1953 having stood at about 10 feet O.D.

The clay-loam is hard and tough, contains a scatter of shell-fragments and pebbles and is generally marked by a reticulation of contraction-cracks filled with a lighter ferruginous clay. The colours of the freshly-broken surface may be likened to those of plain chocolate (matrix) and milk chocolate (joint infillings). It is convenient from this point to refer to this clay-loam as the " Brickearth."

At the northern end of the railway wall, the cliff is so much higher that the top of the sands was visible, capped by a layer of laminated brownish clay and sands, resembling the underlying beds, but of duller colour. The waterlain bedded sands, resting on the Brickearth and capped by this laminated-clay layer, will be referred to as Corton Sands (for this name see Reid Moir and Baden-Powell 1938).

At about this point, a bed of shelly sand was found near the base of the Corton Sands, though a careful scrutiny had revealed no trace of shell-bed in the exposure to the south. The shell-debris lay in a " pocket " in a projecting cliff-fragment, in two layers, one of white sand and one of fawn, resting on a thin layer of pebbles over the top of the Brickearth.

Structurally, as far as California Gap, there was no change in the cliff-face, though a slight increase in altitude was accompanied by an increase in the height of the top of the Brickearth

which, at its highest, reached some 32 feet O.D. Beyond this point (see map), there was a gentle decline in Brickearth level.

A second pocket of shell-bearing sands was found on another projecting point of cliff.* Here it was possible to measure the section carefully and, as this was the thickest shell-deposit noted, a " detail " section of the shell-bearing layers was made.

Section No. 1. At the base is dark-brown clay-loam (Brickearth) irregularly crossed by contraction-cracks filled with lighter ferruginous clay. Shell fragments and occasional flint pebbles are scattered throughout the mass. Above lie waterlain bedded Corton Sands, showing ferruginous bands and false-bedding in places and with thick shell-beds. Above the Sands are laminated beds of brownish clay and sands, on which rests dune-sand with buried turf-lines.

Northward from the highest point of the Brickearth, the shell-beds were seen as a continuous layer lying near the base of the Corton Sands, just above the top of the Brickearth, but dwindling rapidly close to California Gap.

Section No. 2. Similar to No. 1, except that a small pit at the top (now sectioned by the retreat of the cliff-top) has lost the dune-sand and topsoil, present a few feet behind. Thick shell-beds present in the Corton Sands, but in lesser quantity than in No. 1.

Section No. 3. Similar to Nos. 1 and 2. The top of the Brickearth is descending slightly and the shell-beds are still widely spaced in the Corton Sands.

A section on the northern angle of the Gap showed that the thick beds of shelly sand had become thin lines and seams, some of which were so thin as to be almost unnoticed.

Section No. 4. At the base is Brickearth similar to that in No. 1, but with its top much lower. Above are Corton Sands, but without the thick shell-beds seen in the earlier sections. There are a few thin layers with sparse shell, but most of the beds are represented by single lines of shell fragments, with an occasional pocket of shell and small pebbles " suspended " from the line. Above, the top of the Sands and the laminated clays are obscured.

The upper part of the cliff at this point (see Section No. 4) was obscured by rain-wash, but it probably consisted of the laminated sands and clay already noted. But now, a few feet further north, a fresh formation appeared near the top of the

*The " points of cliff " just to the north of the railway wall seem to have been due to the presence of groynes in the beach. Wherever a groyne was not backed by sea-wall, the surge appears to have swirled against the cliff on the north side of the groyne and so carved out a " bay," leaving two projecting points. Similar, but smaller, " bays " appeared to the south where the lower sea-wall was not backed by the upper breastwork.

CLIFF-SECTIONS

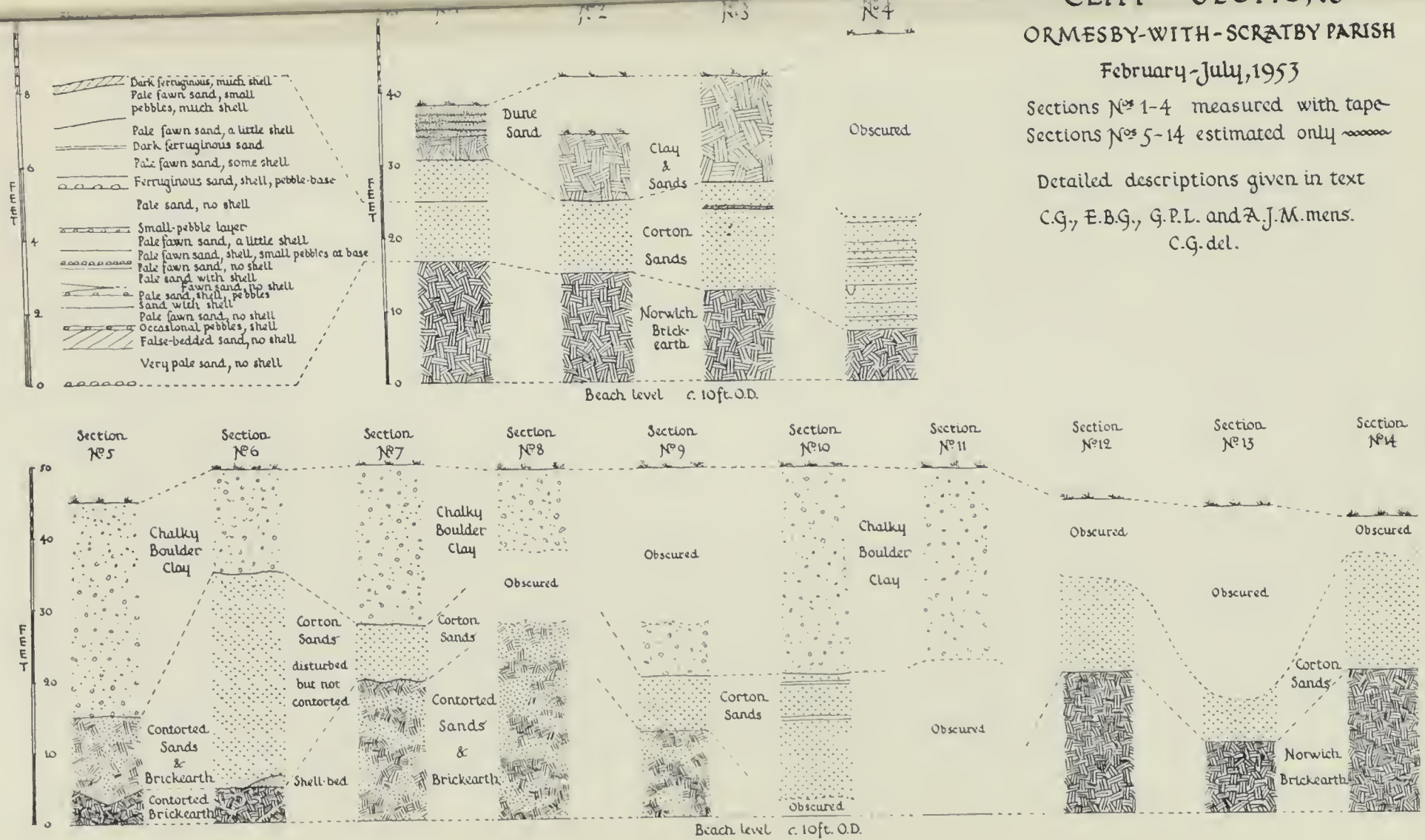
ORMESBY-WITH-SCRATBY PARISH

February-July, 1953

Sections Nos 1-4 measured with tape
Sections Nos 5-14 estimated only ~~~~

Detailed descriptions given in text

C.G., E.B.G., G.P.L. and A.J.M. mens.
C.G. del.



cliff, a mixed clay of varying pinkish and greyish colouring with a considerable mixed rock-debris content. A little beyond, the underlying Corton Sands and Brickearth began to show signs of disturbance until, at a point some 900 feet north of the Gap, the sands and clay-loam were caught up in violent whorls, whole masses of the Sands being enclosed in clay-loam envelopes (Plate II).

Contortions of this type were observed to a point some 1,600 feet north of California Gap, where the talus from the topmost clay-beds, by this time (April) accumulating in some quantity—and in places not entirely swept away by the surge—began to change colour. A bluish-white tinge slowly replaced—particularly in the more weathered material—the pinkish-grey of the upper clay to the south. This was apparently due to the occurrence of quantities of chalk debris. Hereabouts clearly lay the "line of contact of Great Eastern Chalky Boulder Clay with Great Eastern Jurassic Boulder Clay" already mentioned (Sainty 1951, following Baden-Powell 1948, with different nomenclature). The division marked in our map lies a little to the north of this colour-change. The precise method of its determination is described below (see p. 337).

From this point northward a number of sections were sketched. These show (Sections Nos. 5–14) the extent of the disturbance in the remaining part of the exposed cliff-face. The last clearly-exposed Brickearth lay some 60 feet north of Scratby "north beach staircase," though indications had been seen to a point a little further north, where the dune-belt sweeps inland (see map). By the time these sections were recorded, talus had again begun to cover the cliff-face and the points selected were those which gave the best results.

Section No. 5. At the base, contorted Brickearth without incorporated Corton Sands. Above are violently contorted mixed Sands and Brickearth. On these lies Chalky Boulder Clay, partly obscured, but appearing again at the cliff-top.

Section No. 6. At the base is contorted Brickearth without incorporated Corton Sands. Above lie Corton Sands, disturbed but not contorted. Resting on the Brickearth at the northern end is a thickened shell-bed with pebbles.

Section No. 7. At the base, contorted Brickearth with incorporated Corton Sands. Above lie even-bedded Sands without shell. Above again, to the cliff-top, is Chalky Boulder Clay.

Section No. 8. Below, a much thicker layer of contorted Brickearth with incorporated Sands, passing into an obscured area, at the top of which is Chalky Boulder Clay, visible to the cliff-top.

Section No. 9. At the base is contorted Brickearth with scattered shell-fragments, thoroughly mixed with fine light-brown shelly sands, and containing blocks of cemented sands marked by shelly ferruginous sandstones. On these contorted beds lie even-bedded light-buff Corton Sands without shell. Over these is the Chalky Boulder Clay, the top of which is obscured.

Section No. 10. A few feet of the base obscured. Above are Corton Sands, fine light yellow to brown sands without shell or pebbles. Near the top of these beds is an intermittent, somewhat clayey, band with large subangular flint nodules and chalk pebbles of wide range of size. No shell. Above again is another band of more clayey material with many chalk pebbles. Above this is bright yellow sand with very finely granulated chalk. Over this, to the cliff-top, lies Chalky Boulder Clay.

Section No. 11. The base of the cliff obscured. Boulder Clay lies above to the top of the cliff.

Section No. 12. At the base, rising towards the south, is greyish-brown clay-loam irregularly crossed by contraction-cracks with lighter ferruginous clay filling. The clay-loam is silty and not very tenacious, with a sparse scatter of shell fragments and occasional small flint pebbles. Resting on this Brickearth are even-bedded Corton Sands, their top being obscured.

Section No. 13. Similar to No. 12. The top of the Brickearth is lower.

Section No. 14. Similar to No. 12. The top of the Brickearth is higher than in No. 13.

The shell-beds which, for practical purposes disappeared north of California Gap, appeared again in this northernmost sector for, close to the Scratby Beach Road staircase—between Sections 4 and 5—a shell-bed, resting on a clayey band, was noted. In Section No. 5, the undisturbed Sands showed no shell-bed, but the sand-content of the underlying mixture was shelly. In Section No. 6, shell-debris was seen at the base of the Sands. North of this, the shell-beds were again absent.

Disturbance of the Corton Sands and Brickearth ceased a few feet south of Section No. 10. It is significant that the point where the Boulder Clay changes colour, a few feet south of where the division has been fixed, lies exactly midway between the ends of the exposed disturbance. It is noticeable also, that beyond the area of disturbance, the upper level of the Brick-earth is comparable with its level south of California Gap.

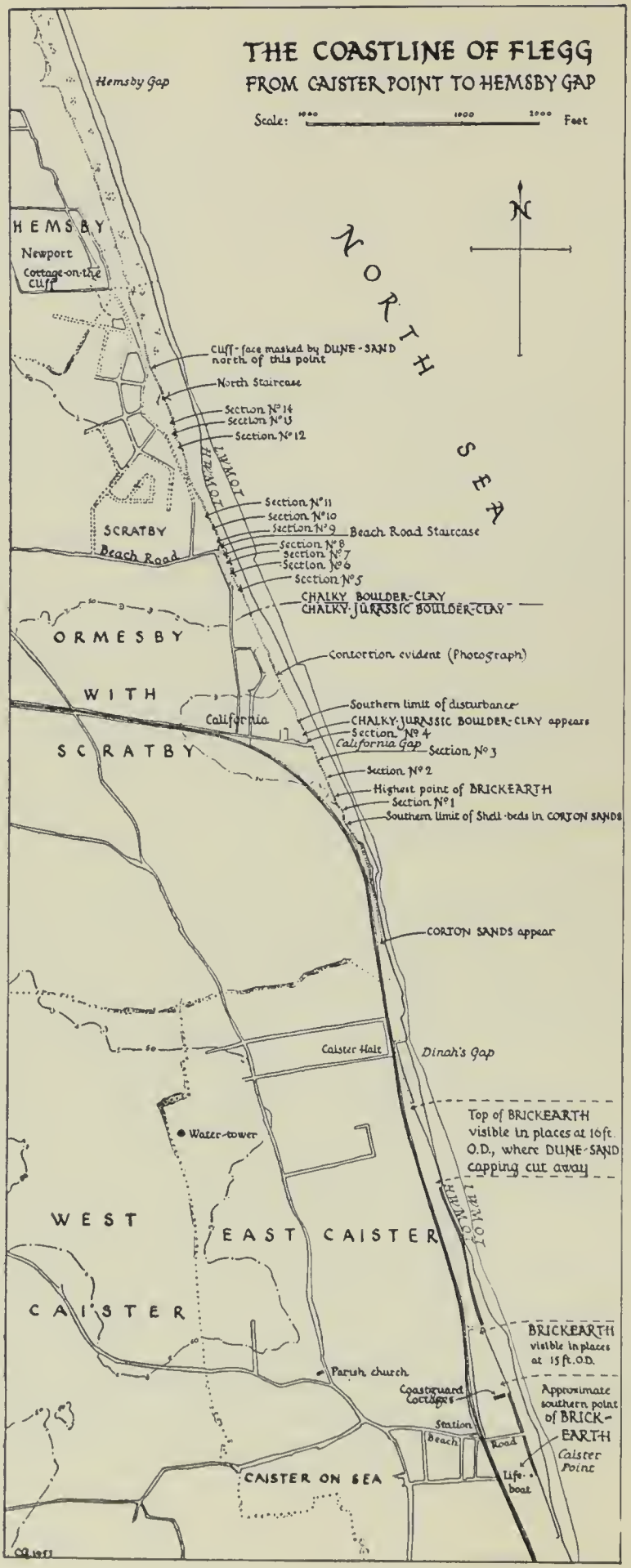

THE COASTLINE OF FLEGG
FROM CAISTER POINT TO HEMSBY GAP
Scale: 1000 0 1000 2000 Feet
Hemsby Gap
HEMSBY
Newport
Cottage on the Cliff
NORTH SEA
N
Cliff-face masked by DUNE-SAND north of this point
North Staircase
Section N°14
Section N°13
Section N°12
LAYHOT
Section N°11
Section N°10
Section N°9
Beach Road Staircase
Section N°8
Section N°7
Section N°6
Section N°5
SCRATBY
Beach Road
CHALKY BOULDER-CLAY
CHALKY-JURASSIC BOULDER-CLAY
ORMESBY
WITH
SCRATBY
Contortion evident (Photograph)
Southern limit of disturbance
CHALKY-JURASSIC BOULDER-CLAY appears
Section N° 4
California
California Gap
Section N° 3
Section N° 2
Highest point of BRICKEARTH
Section N°1
Southern limit of Shell-beds in CORTON SANDS
CORTON SANDS appear
Caister Halt
Dinah's Gap
Top of BRICKEARTH visible in places at 10 ft. O.D., where DUNE-SAND capping cut away
Water-tower
WEST
CAISTER
EAST CAISTER
LAYHOT
BRICKEARTH visible in places at 15 ft. O.D.
Parish church
Coastguard Cottages
Approximate southern point of BRICK-EARTH
Station
Beach
Road
Caister Point
CAISTER ON SEA
Life-boat

PHOTO. I. Manor House Hotel, Caister-on-Sea, April, 1935, showing Brickearth exposed in the cliff.

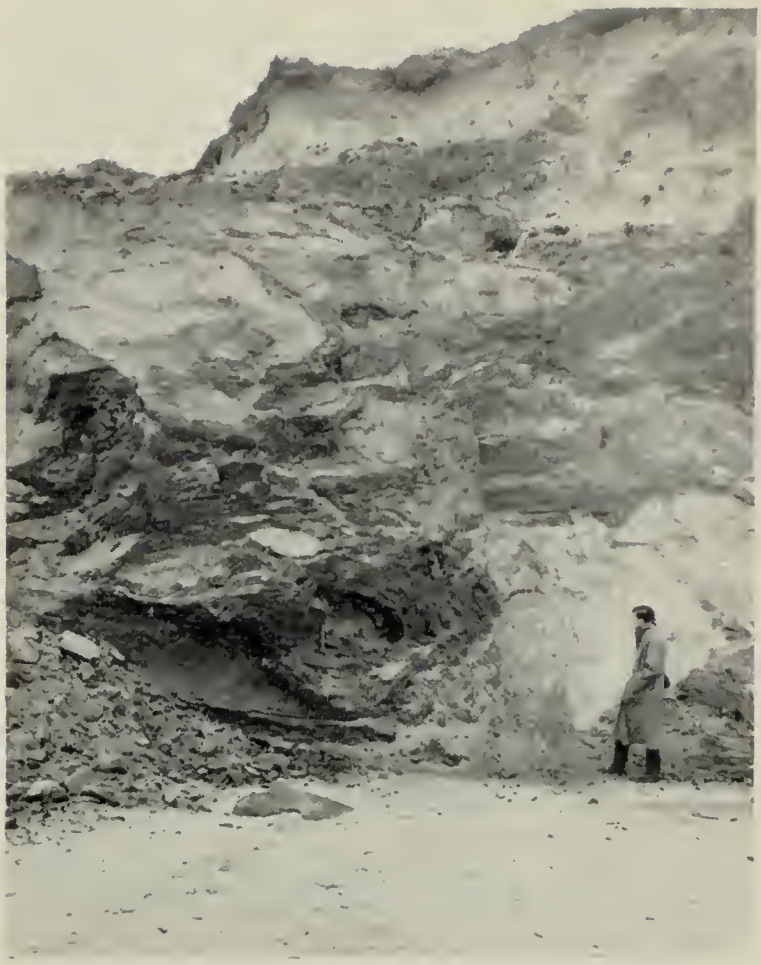


PHOTO. II. Cliff-face at South end of Contorted Sector, April 1, 1953. Intermingled Brickearth and Corton Sands, capped by 'Chalky-Jurassic' Boulder Clay.

Interpretation of the Cliff-Section

(G. P. Larwood and A. J. Martin)

In interpreting the Caister—Scratby cliff sections, the main points of interest are the lithology of the deposits present in the sections, problems of structure and evidence relating to the development of Flegg. The nomenclature is based on the analysis of Baden-Powell and Reid Moir (1942).

I. Brickearth

The basal unit throughout the cliff-section consisted of a development of the Norwich Brickearth (North Sea Drift), a fine-grained, stiff, sandy homogeneous waterlain deposit, which was dark-brown in colour. Within the deposit erratics were rare, but small rounded flint pebbles did occur frequently throughout, together with occasional quartz pebbles and rather larger rounded fragments of quartzitic rocks. Fragmentary shell-remains also were common and were well-worn and often highly polished on the surface. The following have been identified : *Macoma balthica*, *Cyprina islandica*, *Cardium edule*, *Tellina* spp., *Mya* sp., *Mactra* sp., and *Turritella* sp. Further characteristic features of the deposit were the development of many small contraction joints—the joint-planes being picked out by secondary iron-staining—and numerous small calcareous concretions incorporating occasional fragments of chalk and small flint pebbles.

The deposit resembles the Norwich Brickearth of the Norwich area (Woodward 1881) in general appearance, although there are a number of minor differences. While the Brickearth of the Norwich area contains numerous large erratics—mainly of igneous material—and is rather sandy with fewer small flint pebbles, the most important feature is one of similarity, in that there is thorough decalcification of the deposit throughout the whole cliff-section ; only one small chalk pebble was observed and this was heavily impregnated with a secondary iron-deposit. Small secondary calcareous concretions occur in the deposit at Caister. Comparison with the " standard " Till of the Cromer district shows few similarities. The finer, greyish and more tenacious Till, containing many foreign erratics, is in no way decalcified, there being many chalk blocks and fragments present.

II. Corton Sands

The Corton Sands showed well the features associated with conditions of shallow-water marine deposition, such as fine false-bedding, and repeatedly intercalated gravel-seams and coarse ill-graded sands (Wood 1872). Shell remains occurred locally, occupying small lenses and pockets within the deposit except that, immediately south of California Gap, they formed a continuous series extending laterally for some 500 feet and constituted a high proportion of the visible sands. The remains were fragmentary or comminuted and poorly preserved. Their mode of occurrence suggests accumulation in hollows or depressions in the sea-bed, as distinct from aggraded shell-banks such as are found in the Norwich Crag. Thus, while the fauna is considered as indigenous, it does not occur strictly *in situ*, and represents contemporaneous "derivation," probably over short distances. It should, however, be stated that one worn specimen of the distinctive columella of *Voluta lamberti* was found. This species is known to be locally abundant in the Red Crag, but has not been recorded from later deposits except as an obviously derived form. The specimen found would seem without doubt to be so derived.

Locally, some of the finer divisions within the deposit consisted of chalk "sands," the grain-size being usually larger than that of normal quartz sand-grains and very often developing into fine seams of pebble-grade. The constituent chalk pebbles of these coarser seams were very well rounded—often being almost spherical. The occurrence of such "sands" suggests that they were derived from only a short distance. They could possibly originate either from the erosion of a relatively large mass of chalk or from the disintegration of chalk contained in the underlying deposit.

At the top of the Corton Sands, a laminated clayey sequence is developed and this might indicate the final shallowing of the sea in which the Corton Sands were laid down. Where the beds have not been subsequently disturbed, the limits of the Sands, both above and below, are very well defined.

III. Lower Chalky Boulder Clays

Throughout the whole length of the section north of California Gap, the Corton Sands were directly overlain by boulder clay

of limited thickness. This boulder clay could be divided into two separate types—to the north the " Chalky " and to the south the " Chalky-Jurassic "—both being products of the Great Eastern or Lower Chalky glaciation (Baden-Powell 1948). The " Chalky " Boulder Clay was characterized by the presence of considerable quantities of chalk blocks and fragments incorporated in a tenacious bluish-grey clay matrix. In comparison, the " Chalky-Jurassic " Boulder Clay contained few erratics and little chalk, and had a more sandy matrix. In colour the latter was a light brown to buff deposit.

The nature of the matrix and the proportionately great increase of the erratic-chalk content within the clay were the criteria used to determine the position of the lateral junction between the two types, and this was placed some 900 feet south of Scratby (Beach Road) steps. The change in colour between the two boulder clays lay a little to the south. It is difficult, however, to define this junction closely, for a certain amount of mixing must have occurred in " Lower Chalky " times along the line where the separate tongues of the ice-sheet abutted. Furthermore, weathering and slipping on the face of the section tended to obscure the junction.

The terms " Chalky " and " Chalky-Jurassic " could be somewhat misleading as applied to the two component boulder clays exposed in these cliff-sections. For instance, in the " Chalky " boulder clay, a number of Jurassic erratics was present—as is often the case—consisting mainly of Kimmeridgian and Oxfordian types with other Mid-Jurassic and Liassic rocks. Fragments of Red Chalk, sandstones of Palaeozoic aspect and basic igneous rock-types also occurred very occasionally. Blocks and fragments of white chalk and nodular flint vastly outnumbered all other erratics. With regard to the southernmost boulder clay, the term " Chalky-Jurassic " seems to be even less appropriate. None of the erratics found could definitely be assigned to a Jurassic horizon and only occasionally were small chalk pebbles present. Flint, however, was more common. The other erratics which were found consisted almost exclusively of relatively small and quite well-rounded pebbles of quartz and well-compacted quartz sandstones with very occasional igneous and metamorphic fragments. The matrix resembled very closely that of the Brickearth at the base of the sections.

It is suggested that this boulder clay is at least partly decalcified. This process could account for the absence of chalk and, to a lesser extent, of Jurassic erratics, and for the apparent concentration of more resistant siliceous erratics of the types mentioned. Also the more open, sandy matrix of this southernmost boulder clay would possibly facilitate such a process of decalcification. However, considering the position of this boulder clay and its field-relationship to the " Chalky " boulder clay to the north, there is little doubt that it is an unusual local development of the " Chalky-Jurassic."

IV. Problems of Structure

Some 200 feet north of California Gap the cliff-section exposures show the Corton Sands and the underlying Brickearth to be disturbed, a disturbance which increases to the north and, at some 900 feet north of the Gap, becomes violent contortion (see Plate II). The latter is continued northward for some 1,600 feet, beyond which it lessens and the beds show varying disturbance with the contortion restricted to a thin basal zone, and finally disappears a further 500 feet to the north (see Section No. 10).

The distinction between " contortion " and " disturbance " is one of degree. " Contortion " involves the elongation, drawing and pinching-out of beds, together with the rolling and convolution of individual seams. The contortion involves not only considerable intermixing of beds within the Corton Sands themselves, but also between the latter unit and the underlying Brickearth. In the most intensely contorted section, tongues and masses of the Brickearth have been incorporated within the Corton Sands and vice-versa. Some of these contorted masses have been somewhat rounded by rolling and drawn out at either end of their long axes. The term " disturbance " is used to describe slightly warped and undulating beds. In that part of the cliff-section described as " disturbed," Corton Sands and the Brickearth are warped together but never mixed.

The contortions within the Corton Sands are less intense towards the top of the deposit, and the junction between the Sands and the Boulder Clay above is only slightly plucked and puckered. Throughout the section, the Boulder Clay, at the

most, was only slightly disturbed. It is significant that the contortions in the Sands and Brickearth are limited to a belt which coincides with the zone of junction between the " Chalky-Jurassic " and " Chalky " Boulder Clays. At this point, two separate tongues of the Lower Chalky ice-sheet merged (Baden-Powell 1948), and resulted ultimately in the two types of boulder clay being deposited in juxtaposition. It is thought that the merging of the two tongues of ice—possibly facilitated by side-slipping along the slopes of a wide east-west valley-feature—increased the compressional effects of the ice, and was directly responsible for producing the limited belt of violent contortions seen in the Corton Sands and the underlying Brickearth.

It is further suggested that, as the Sands and Brickearth—apart from this contorted belt—are only slightly disturbed, no great thickness of ice was developed in the area in Lower Chalky times. Only the less effective thinner fringe of the margin of the ice-sheet was present and the ice became effective as a mechanical force only where the two tongues were combined in the way suggested above. As previously mentioned, the more violent contortions tend to be limited vertically in the sections towards the base of the Corton Sands and at the top of the Brickearth. It is quite probable that, during the Lower Chalky glaciation, the Corton Sands and the Brickearth were frozen into more competent units. Apparently the Sands—in a frozen condition—moved with the ice to some extent and thus the main plane of movement was not between the Corton Sands and the ice-sheet, but at the base of the Sands and at their junction with the Brickearth. Such movement would involve only the restricted local dragging of the Corton Sands, and tended to limit the vertical extent of violent contortions to the level mentioned.

Flegg as an Individual Feature

(G. P. Larwood, A. J. Martin and Charles Green)

East Norfolk and North-east Suffolk are drained by the rivers Bure, Yare and Waveney and their tributaries. As they approach the sea, their valleys converge and widen out to form a wide plain of alluvium (drained marsh), through which

the rivers wind to join and enter the sea south of Great Yarmouth. It has long been accepted that this alluvial plain, which includes " The Broads," fills what was at one time a true estuary, in which stood various islands. In the northern part of this " great estuary," the two Hundreds of East and West Flegg together form the biggest of these islands.

Flegg island is bounded on the east by the North Sea, on the north by the " Hundred Stream " and the river Thurne, on the west by the Thurne and the Middle Bure, and on the south by the Lower Bure. This river, near the south-east point of the island, is deflected southwards by the northern part of the Yarmouth Spit which, as has already been shown, abuts on the island at Caister.

Lambert (1952) and Jennings (1952, 1953) conveniently bring together the results of their many years' work and show that two transgressions of the sea—one perhaps in Neolithic times (*cf.* Clark 1935) and a second, of greater extent, at the beginning of our era—are the proximate beginning of that " evolution " which has taken place in the valleys in historic times. This has been due to silting, to the growth of the Yarmouth Spit, which obstructed tidal scour, to the formation of peat-beds and to human activities directed to land reclamation.

But the basic structure of the estuary is far older than this. Harmer (1908) has shown that, in the valley of the Yare (Wensum) below Norwich, the Lower Chalky Boulder Clay ran down into the pre-existing valley, which was cut into the Norwich Brickearth and its overlying Sands. Similar observations have been made in the Bure valley (Chatwin 1948). On this firm foundation, a study of our sections, supplemented by those of Blake (1890), helps to give some idea of the development of Flegg as a topographical unit, and such a course of development is tentatively outlined.

The previous topography was apparently obliterated with the onset of the first major glaciation and the deposition of the Brickearth, which to-day is the basal deposit observed throughout Flegg above Ordnance Datum.

A rise in the sea-level resulted in the deposition of the marine Corton Sands over the whole area now occupied by Flegg and, as the sea sank once again, derived loamy clay was in places deposited to seal the top of the Sands.

Major valleys were now cut, producing a well-defined topography, leaving the Flegg area dissected from the " mainland " to north, west and south.

With the onset of the Lower Chalky glaciation and the resultant fall in sea-level, Flegg was a marked topographical feature. This feature, however, was not sufficiently pronounced to act as a barrier, even to the weaker margins of the ice, for a relatively thin cover of boulder clay was deposited over the area which, when later surface erosion took place, served to accentuate its prominence.

The rise in sea-level after the retreat of the Lower Chalky ice probably left the area picked out as an island. There is no recorded evidence of the occurrence of deposits of the Upper Chalky glaciation in this area, the distribution maps (Baden-Powell 1948) showing, indeed, that the nearest edges of the deposits lay far to the north, west and south.

It was, apparently, the tough, resistant base of Brickearth which met the waters of the two recent transgressions and so preserved the essential features of the island in prehistoric and early historic times. The surface exposures during this period,

(a) boulder clay on the higher inland slopes

(b) loamy sands in a surrounding belt, with

(c) a stiff brickearth periphery,

were doubtless significant in sustaining a tree-growth which discouraged early settlement before the establishment of a Roman settlement in the island (Green 1952).

[A report on the fauna of the shell-beds of the Corton Sands in the Caister-Scratby cliff-sections will be published later].

REFERENCES.

BADEN-POWELL, D. F. W. (1948). " The Chalky Boulder Clays of Norfolk and Suffolk." *Geological Magazine*, 85 : 279–296.

BADEN-POWELL, D. F. W. and MOIR, J. REID (1942). " On a New Palaeolithic Industry from the Norfolk Coast." *Geological Magazine*, 79 : 209–219.

BLAKE, J. H. (1890). " The Geology of the District Around Yarmouth and Lowestoft." *Memoirs of the Geological Survey.*

CHATWIN, C. P. (1948). *British Regional Geology, East Anglia.* Second Edition, London.

Clark, J. G. D., Godwin, H. and M. E., and Clifford, M. H. (1935). "Report on Recent Excavations at Peacock's Farm, Shippea Hill, Cambridgeshire." *Antiquaries Journal*, xv : 284–319.

Cotton, K. E. (1952). Description of the borings for the Caister sea-wall "sheathing." *In litt.*, January 29th, 1952.

Ellis, E. A. (1934). Unpublished observations.

Green, Charles (1952). "Excavations at Roman Port in East Anglia." *The Times*, February 2nd, 1952. Full report forthcoming.

Harmer, F. W. (1908). "The Pleistocene Deposits of the Eastern Counties of England." *Geology in the Field*, Jubilee Vol. Geological Association.

Haylett, R. H. (1951). Verbal description of stripped beach.

Jennings, J. N. (1952). *The Origin of the Broads*. London : R.G.S. Research Series, No. 2.

Jennings, J. N. and Lambert, J. M. (1953). "The Origin of the Broads." *Geographical Journal*, cxix (1) : 91.

Lambert, J. M. (1952). "The Past, Present and Future of the Norfolk Broads." *Trans. Norfolk and Norwich Nat. Soc.*, xvii (4) : 223–258.

Moir, J. Reid and Baden-Powell, D. F. W. (1938). "A Palaeolithic Industry from the Cromer District." *Nature*, 142 : 912.

Sainty, J. E. (1951). "The Geology of Norfolk." *Trans. Norfolk and Norwich Nat. Soc.*, xvii (3) : 149–185.

Steers, J. A. and Jensen, H. A. P. (1952). "Winterton Ness." *Trans. Norfolk and Norwich Nat. Soc.*, xvii (4) : 259–274.

Wood, S. V. (1872). "First Supplement to the 'Crag Mollusca'" : Introduction. *Mon. Palaeontographical Soc.*, London.

Woodhouse, J. (1953). Verbal description of stripped beach. The dates of the gales confirmed by entries in the Caister Lifeboat logbook.

Woodward, H. B. (1881). "The Geology of the Country around Norwich." *Memoirs of the Geological Survey*.

Zeuner, F. E. (1944). *The Pleistocene Period*, pp. 101–4. London : Ray Society.

LIST OF MEMBERS, 1952-53

Gen. = *General* | *P.* = *Plants* | *Geol.* = *Geology*
Birds | *F. W. Biol.* = *Fresh Water Biology* | *Mam.* = *Mammals*
Ins. = *Insects* | *Sp.* = *Spiders* | *M. Biol.* = *Marine Biology*
*Life Member | †Honorary Member | ‡Family Member

A

Elected.		
1952	Adcock J. A., 50, Sandy Lane, Norwich	*P.*
1939	Addison, Rev. W. R., V.C., Coltishall Rectory, Norwich	*Gen.*
1936	Ali Miss E. M. S., 60, Beaconsfield Road, Norwich	*Gen.*
1946	Allen Capt. G. S., East Hall Farm, Langham, Holt	*Birds*
1952	Amherst of Hackney, Lord, Foulden Hall, Thetford	*Gen.*
1925	Anderson Dr. T., 386a, Unthank Road, Norwich	*Geol.*
1947	Andrew E. S., 37, Springfield Rd., St. Leonards, Sussex	*Gen.*
1952	Armitage Miss G., Gordon Road, Melton Constable	*Gen.*

B

1919	†Back H. W., Hethersett Hall, Norwich	*Gen.*
1935	Back Mrs. H. W., Hethersett Hall, Norwich	*Gen.*
1945	Backhouse Rev. T. P., The Rectory, Caistor St. Edmunds	*Birds*
1933	Bacon Sir Edmund, BT., Raveningham Hall, Norfolk	*Birds*
1939	Bagnall-Oakeley R. P., Brinton Hall, Melton Constable	*Birds, Mam., P.*
1952	Bailey W. G., The Post Office, Litcham, King's Lynn	*Birds*
1945	Bainbridge P., Orchard Hill, Coltishall, Norwich	*Gen.*
1945	Bainbridge R. J., Apple Tree Farm, Gt. Plumstead	*Gen.*
1949	Baker T. H. M., Ollands, Little Baddow, Chelmsford, Essex	*Birds*
1939	*Barclay Brig. F. P., D.S.O., M.C., Cliff Lane Cottage, Cromer	*Birds*
1948	Barker Miss J., Shelfanger, Christchurch Road, Norwich	*Gen.*
1953	Barmby Miss S. M., 146, Woodcock Rd., St. Clement's Hill, Norwich	*P.*
1921	†Barnard Miss G. V., M.B.E., Longfields, Wymondham	*P.*
1948	*Barnes Miss R. M., 171, Angel Road, Norwich	*Gen.*
1953	‡Barnes R. F., 171, Angel Road, Norwich	*Gen.*
1937	Barrett J. H., Dale Fort Field Centre, Haverfordwest, Pembrokeshire	*Gen.*
1927	*Barrington F. J. F., 14a, Upper Wimpole Street, W.1.	*Gen.*
1952	Barry D. H., B.SC., Kumasi College of Technology, Private Bag, P.O. Kumasi, Gold Coast	*F. W. Biol.*
1953	Barton C., Shotesham Lodge, nr. Norwich	*Birds*
1953	Baxter N. J., Syderstone, King's Lynn	*P.*
1953	Beeson Miss G., 216, Unthank Road, Norwich	*Gen.*
1947	Benn Miss N., 49, Cromer Road, Norwich	*P.*
1952	Bennell Mrs. C. O., Quaker Farm, Haveringland, Norwich	*Gen.*
1934	*Bennett W. W., 58, Elm Tree Road, Lowestoft, Suffolk	*Gen.*
1921	*Berney F. L., R.A.O.U., c/o Archer Bros., Gracemere, Rockhampton, Queensland, Australia	*Birds*
1949	Bickmore Dr. M. H., Westfield, Lydney, Gloucestershire	*Gen.*
1953	Bidwell Miss M. A., St. Thomas's Vicarage, Earlham Road, Norwich	*Gen.*
1921	Bignold Sir Robert, 125, Newmarket Road, Norwich	*Gen.*
1947	Birkbeck H., Westacre Abbey, King's Lynn	*Gen.*
1901	Birkbeck Major H. A., Westacre High House, Castle Acre, King's Lynn	*Birds*
1946	Bitton E. Quinton, F.Z.S., Church Farm, Runhall, Norwich	*Birds, F. W. Biol., P.*
1933	Blackburne C. L., Weydown Hatch, Halsemere, Surrey	*Birds*
1930	Blake Mrs., The Red House, Bradeston, Brundall, Norwich	*Gen.*
1925	Blofeld T. R. C., Hoveton House, Wroxham, Norwich	*Gen.*

Elected		
1939	Boardman H. C., " Byways," Eaton Chase, Unthank Rd., Norwich	*Gen.*
1938	Boardman M. R., How Hill, Ludham, Gt. Yarmouth	*Gen.*
1936	Bolingbroke Miss C., Ferryside, Riverside Road, Norwich	*Birds*
1924	Boyd A. W., Frandley House, Northwich, Cheshire	*Birds, Ins.*
1915	Bradfer-Laurence H. L., F.S.A., Sharrow End, Ripon, Yorks.	*Gen.*
1947	Bradshaw A. D., 11, Ornan Road, London, N.W.3.	*Gen.*
1953	Braybrooks F. T., Penshaw, Surlingham, Norwich	*Gen.*
1944	‡Brereton J., Brampton Hall Farm, Norfolk	*Gen.*
1952	Brett I., Woodgate House, Aylsham, Norfolk	*P.*
1951	Briscoe Lt.-Col. F. E. D. Drake-, 86, Newmarket Rd., Nch.	*Mam.*
1946	Brooks A. B., Haynes Green, Layer Mainey, Essex	*Birds*
1952	Brooks Mrs. E. M., The Manor, Ludham, Norfolk	*Gen.*
1925	Brooks J. R., North Walsham Wood, Norfolk	*Birds*
1925	Brooks Mrs. J. R., North Walsham Wood, Norfolk	*Birds*
1941	Brown C. Clifton, Congham Lodge, Hillington, King's Lynn	*Gen.*
1949	Brown C. W., ' Jesmond Dene," Croxton Road, Thetford	*Birds*
1953	Brummage J. H., Heathwoods, Taverham, Norfolk	*Birds*
1953	Brunning Miss L. F., 38, Prickwillow Rd., Ely, Cambs.	*P.*
1921	Bruton M. S., Norfolk House, Aylsham, Norfolk	*Birds*
1925	Bryan H., Well Cottage, Wiveton, Holt	*Gen.*
1947	Bryan Mrs. H., Well Cottage, Wiveton, Holt	*Gen.*
1939	Buckingham Mrs. B., Aylsham, Norfolk	*Gen.*
1944	*‡Buckton Dr. P. R., Abbotsford, Vicar Street, Wymondham, Norfolk	*Gen.*
1948	Buddell Rev. J. L., Trevangon, The Rise, Sheringham	*Gen.*
1925	Bulwer Mrs., The Old Cottage, Heydon, Norwich	*Gen.*
1923	Burton A., Stenson, Cromer, Norfolk	*Gen.*
1923	Burton Mrs. A., Stenson, Cromer, Norfolk	*Gen.*
1936	Burton Miss F. W., 60, The Close, Norwich	*Gen.*
1952	Bush Miss J. M., 30, Grove Walk, Norwich	*P., Birds*
1928	Bushell M. D., Pink Cottage, Dunmow, Essex	*Gen.*
1928	Bushell Wickham Lodge, Wickham Bishops, Essex	
1949	Bussey B., The Laurels, Belaugh, Wroxham	*Ins.*
1947	Buttery Miss E. M., Norwich Training College, Keswick	*Gen.*
1921	*Buxton Major A., D.S.O., Horsey Hall, Gt. Yarmouth	*Birds, Mam.*
1923	Buxton Rev. A., Upton House, Cromer, Norfolk	*Gen.*
1923	*Buxton Major I., c/o Truman's Brewery, Brick Lane, Spitalfields, London, E.1.	*Gen.*
1946	Buxton J., Horsey Hall, Gt. Yarmouth	*Birds*
1906	Buxton Capt. R. G., Wiveton Hall, Holt, Norfolk	*Gen.*
1906	Buxton W. L., Bolwick Hall, Marsham, Norfolk	*Birds, P.*

C

1953	Cadbury C., Beaconwood, Rednal, Birmingham	*Birds*
1950	Caffyn Mrs. M. L., 3, Evesham Road, Reigate, Surrey	*Gen.*
1948	Cain J. Tyson, 8b, Christopher Close, Norwich	*Gen.*
1949	Campbell Dr. J., 272, Unthank Road, Norwich	*Gen.*
1948	Carlson Dr. K. J., 127, Aylsham Road, Norwich	*Birds*
1953	Carr J. U., Braunston House, Broomhill, Downham Mkt.	*Birds, Ins., Mam.*
1953	Carrick Miss A. M., Castle Farm, Swanton Morley, E. Dereham, Norfolk	*Birds*
1924	Carruthers D., Elders Farm, Grimston, King's Lynn	*Gen.*
1948	Cartmell Mrs. E. A., Belaugh, Wroxham, Norfolk	*Gen.*
1924	Cator Lt.-Col. H. J., Woodbastwick Hall, Norwich	*Birds*
1933	Cazenove Mrs., The Old Manor, Ham, Shepton Mallet, Som.	*Gen.*
1926	Chadwick Dr. M., 3, King Street, King's Lynn	*Gen.*
1941	*Chandler Dr. G. C. H., M.R.C.S., L.R.C.P., The Rectory House, Saxthorpe, Norwich	*Geol.*

Elected		
1945	Chenevix-Trench G. C., Rocklands, Weybourne, Holt	*Gen.*
1907	Christie J. A., Framingham Manor, Norwich	*Gen.*
1927	Clarke Miss L. R., 12, St. Phillip's Road, Norwich	*Gen.*
1952	‡Clarke R. Rainbird, Castle Museum, Norwich	*Geol.*
1948	Cock J. H., Abbey Farm, Guestwick, East Dereham	*Gen.*
1945	Coke Col. R. E., Oaklands, North Street, Sheringham	*Gen.*
1923	Cole Lowry A. C., Sprowston Lodge, Rackheath, Norwich	*Gen.*
1923	Cole Mrs. Lowry A. C., Sprowston Lodge, Rackheath, Nch.	*Gen.*
1944	Collins W. A. R., 14, St. James' Place, London, S.W.1.	*Gen.*
1945	Colman T., Framingham Chase, Norwich	*Birds*
1949	Cook A. L., 48, Telegraph Lane E., Thorpe Hamlet, Norwich	*Gen.*
1925	Copeman T. D., " The Pightle," 46, Common La., Sheringh'm	*Gen.*
1945	Corfe Miss I. W., " Brentwood," 106, Norwich Road, North Walsham, Norfolk	*Birds*
1953	Cotton K. E., M.I.MUN.E., The Vicarage, Surlingham, Nch.	*Gen.*
1921	Cozens-Hardy A., Oak Lodge, Sprowston, Norwich	*Gen.*
1935	Cozens-Hardy Miss, Oak Lodge, Sprowston, Norwich	*Gen.*
1945	Cozens-Hardy B., Glavenside, Letheringsett, Holt	*Birds*
1953	Cranbrook The Rt. Hon. The Earl of, Great Glemham House, Saxmundham, Suffolk	*Mam.*
1952	Cresswell Miss I. M. N., 20a, Christchurch Road, Norwich	*Gen.*
1951	Crickmore E., 204, Earlham Road, Norwich	*Gen.*
1953	Croghan P. C., 18, Hill House Road, Norwich	*F. W. Biol.*

D

1953	Dady A., 561, Earlham Road, Norwich	*Geol.*
1928	Daniels E. T., 352, Dereham Road, Norwich	*Ins., Birds*
1923	Daukes Major A. H., 50, Egerton Gardens, London, S.W.3.	*Gen.*
1952	Davies Miss A. M., 125, Holbein House, London, S.W.1.	*Gen.*
1914	Davies H. C., The Lodge, Old Lakenham, Norwich	*Gen.*
1948	Davis H. B., High Road, Drayton, Norwich	*P.*
1941	Davis H. H., Little Stoke, Patchway, Bristol	*Gen.*
1948	Dawson Miss E. P., School House, North Elmham, Norfolk	*Gen.*
1917	Deacon Dr. G. E., Brundall, Norwich	*Ins.*
1936	Dewhurst J. E., Riverside House, Reedham, Norfolk	*Gen.*
1941	Digby P. S. B., 12, Birch Tree Avenue, West Wickham, Kent	*Gen.*
1947	Duff Miss M. G., Norwich Training College, Keswick, Nch.	*Gen.*
1953	Duffey E. A. G., 400, Dereham Road, Norwich	*Ins., Sp.*
1952	Dunbar Miss M. S., Alderfen Cottage, Neatishead, Nch., Nfk.	*Gen.*
1948	Dunbar Capt. R. E. C., R.N., Alderfen Cottage, Neatishead, Norwich, Norfolk	*Gen.*
1949	Durrant K. C., 83, Sandy Lane, E. Dereham, Norfolk	*Ins.*

E

1950	Easter Miss D. M., 99, City Road, Norwich	*Gen.*
1953	Edmonds P. J. K., Grange Farm, Hindringham, Fakenham	*Birds*
1953	Edwards Miss W., The Villas, Redenhall, Harleston, Norfolk	*Gen.*
1939	Ellis A. E., Epsom College, Epsom, Surrey	*P.*
1929	‡Ellis E. A., F.L.S., Wheatfen, Surlingham, Norwich	*Gen.*
1938	Ellis Mrs. E. A., Wheatfen, Surlingham, Norwich	*P.*
1936	Ellis Dr. M. B., Commonwealth Mycological Inst., Kew, Surrey	*Ins., Birds*
1953	Ellison Miss P., 27, Queen's Drive, Barnsley, Yorks.	*Gen.*
1951	Emms H. C., Rose Cottage, Ketteringham Park, Norfolk	

Elected		
1946	Euren Miss H. M., 20, Recreation Road, Norwich	*Gen.*
1946	Euren Miss M. D., 20, Grange Road, Norwich	*Gen.*
1948	Evans-Lombe, Vice-Admiral E. M., 47, Hornton Court, Kensington, London, W.8.	*Birds*

F

1936	Farrell Miss E. M., 79, Christchurch Road, Norwich	*Gen.*
1927	Fawkes Dr. R. B., Rede's House, Cromer, Norfolk	*Gen.*
1950	Feetham Miss E. L., 186, College Road, Norwich	*Gen.*
1922	*Ferrier Miss J. M., F.Z.S., M.B.O.U., Blakeney Downs, Blakeney, Holt, Norfolk	*Birds*
1949	Fiddian W. E. H., 15, Russell Avenua, Sprowston, Norwich	*Birds*
1951	Fiddian Mrs. W. E. H., 15, Russell Avenue, Sprowston, Nch.	*Birds*
1936	Finch C. H., Costessey House, Norwich	*Gen.*
1946	Fisher J., M.A., F.L.S., F.Z.S., The Old Rectory, Ashton, Northampton	*Birds, Mam.*
1952	Fletcher Miss E. M. V., Woodlands, Thorpe, Norwich	*Birds*
1946	Fletcher H. N., Bracon Lodge, Braconash, Norwich	*Gen.*
1949	Fletcher Miss N. K., Hollyhocks, Kirby Cane, Bungay	*Gen.*
1949	Flowerdew R. E., Holly Cottage, Repps, Gt. Yarmouth	*Birds*
1952	Forsythe Miss E., Toeston East Farm, North Broomhill, Morpeth, Northumberland	*Birds*
1945	Forsythe J. A., Heathfield House, Brundall, Norwich	*Birds*
1952	Frost L. C., West Green, Poringland, Norwich	*P.*

G

1952	Gardner R. H., " Hollies," London Road, Harleston	*Gen.*
1953	Garlick Miss C. M., Goose Lane, Alby, Aldborough, Norwich	*P., Birds*
1953	Garrard Miss M., Westbourne House, Coltishall, Norwich	*P.*
1927	Gay Miss C. E., Little Toft, Stoke Holy Cross, Norwich	*Birds*
1953	Gayford Miss E., 39a, Thorpe Road, Norwich	*Gen.*
1952	George Miss A. E., 33, St. William's Way, Thorpe	*Gen.*
1928	George S. S., White House, Saham Toney, Thetford	*Gen.*
1951	Gibbons Miss G. O., Mercam, Cantley Lane, Cringleford, Nch.	*Geol.*
1933	Gibson Mrs. C. M., 63, Newmarket Road, Norwich	*Gen.*
1947	Gilbert Miss B. F., Deva House, Olney Road, E. Dereham	*Gen.*
1951	Giles W. W. E., M.A., F.R.G.S., Ketteringham Hall, Norfolk	*Gen.*
1950	Glendenning Lt.-Col. S. E., 84, Rosary Road, Thorpe Hamlet, Norwich	*Gen.*
1950	Goff Miss I., Fenn Farm, Barnham Broom, Norwich	*Gen.*
1944	Goff M. G. T., 293, Aylsham Road, Norwich	*Gen.*
1952	Goldsmith E. T., 58, Fair Close, Beccles, Suffolk	*Ins.*
1947	Goom Miss E. M., 78, Elmfield Ave., Teddington, Middlesex	*Birds*
1953	Gordon W. A., 70, Springfield Road, Gorleston	*Geol.*
1952	Gosling C., Seamere, Hingham, Norwich	*Birds*
1952	Gosling Mrs. A., Seamere, Hingham, Norwich	*Birds*
1949	Gosnell V., Friday's Bungalow, Salthouse, Norfolk	*Gen.*
1945	Gould D. A. Pearce, 8, Upper King Street, Norwich	*Gen.*
1939	Gould R. Pearce, Lime Tree House, Lime Tree Rd., Norwich	*Gen.*
1946	Gowing C., Rackheath, Norwich	*Gen.*
1952	Grain G. A., 33, Manor Park Road, Nuneaton, Warwicks.	*Birds*
1953	Gray R. D., Lime Tree Farm, Silfield, Wymondham, Norfolk	*Birds*
1919	Greatorex H. A., Witton, Norwich	*Gen.*
1953	Green C., 105, Beach Road, Caister-on-Sea	*Birds*
1953	Green Roland, Hickling Broad, Norfolk	*Birds*

Elected		
1952	Greenshields Mrs. A. G. D., Holly Grove, Neatishead, Nch.	*Gen.*
1945	Griffiths T., 15, Essex Street, Norwich	*Gen.*
1933	Gurney Miss C., Turleigh Mill, Bradford-on-Avon, Wilts.	*P.*
1929	Gurney J., Walsingham Abbey, Norfolk	*P.*
1952	Gurney Mrs. J. E., Longmoor Point, Catfield, Gt. Yarmouth	*Gen.*
1901	Gurney Q. E., Bawdeswell Hall, Norfolk	*Gen.*

H

1892	*Haigh C. H. Caton, Grainsby Hall, Grimsby, Lincs.	*Gen.*
1947	de Hamell Major E. A., White House, Trimingham, Norfolk	*Birds*
1947	de Hamell Mrs. E. A., White House, Trimingham, Norfolk	*Birds*
1926	Hammond C. R. A., Sprowston Grange, Rackheath, Norwich	*Gen.*
1949	Hammond E. R., Low Common, South Lopham, Diss	*Gen.*
1929	Hamond Com. C. E., R.N., Myrtle Cottage, Porchester, Hants.	*Gen.*
1949	Hamond R., Morston, Holt, Norfolk	*M. Biol.*
1946	Hare Mrs. R., The Paddock, Meadow Lane, Thorpe-next-Norwich	*Birds*
1945	Harmer R., Jesmond, Brundall, Norwich	*Gen.*
1946	Harrison G. C., 68, Earlham Green Lane, Norwich	*Gen.*
1947	Harrison J. C., Grove Cottage, Haynford, Norwich	*Gen.*
1954	Harrison R. E., Billet 8, New Site, R.A.F., Horsham St. Faith, Norwich	*Birds*
1952	Hayes Miss E., Greenacres, Little Melton, Norwich	*Birds*
1952	Hayes Mrs. R. B., Greenacres, Little Melton, Norwich	*P.*
1953	Heawood A. G., Hethersett Rectory, Norwich	*Birds*
1948	Hilbert Miss G. B., West Norfolk and King's Lynn High School, King's Lynn	*Gen.*
1952	Hill C. N. A., 428, Unthank Road, Norwich	*Birds*
1953	Hill Miss J. A., Arch Farm, Westwick, Norwich	*P.*
1920	Hinde Dr. E. B., 4, Branksome Road, Norwich	*P.*
1923	Hines E. S., Eastwood Lodge, Old Costessey, Norwich	*Gen.*
1939	Hoare Miss I. M., Little Crabbetts, Hoveton St. John, Wroxham, Norfolk	*Gen.*
1951	Hodges A. G., 37, Thunder Lane, Norwich	*Birds*
1952	Hook R. I., 1, Francis Court, Earlham Road, Norwich	*Birds*
1919	†Howard H. J., F.L.S., 6, College Road, Norwich	*P.*
1926	Howlett Dr. J. K., Links Tor, Hunstanton, Norfolk	*Gen.*
1931	Hulse Mrs. M. W., Barnham, Meadway, Berkhamsted	*Gen.*
1953	Hurley Miss B. N. E., 40, Charles Avenue, Thorpe, Norwich	*Birds*
1946	Hutchings G. E., Juniper Hall, nr. Dorking, Surrey	*Geol.*

I

1952	Ireland Miss N. E., J.P., Close Lodge, 12, Ipswich Rd., Nch.	*P.*
1951	Irvine T. W., Chedworth Roman Villa, Yanworth, near Cheltenham, Glos.	*Gen.*
1946	Ives R., Erpingham House, Norfolk	*Gen.*

J

1941	Jackson J. K., c/o Research Division, Ministry of Agriculture, Wad Medani, Sudan	*P.*
1937	Jarrold H. J., 415, Unthank Road, Norwich	*Gen.*
1953	Jeeves R. A., 106, George Borrow Road, Norwich	*Birds*
1949	Jermy A. C., Tandem, East Avenue, Brundall, Norwich	*P.*

Elected		
1946	Jessup G., *23*, Dereham Road, Watton, Norfolk	*Birds*
1946	Johnson A. E., 88, Middleton's Lane, Hellesdon, Norwich	*Birds*
1935	Johnson Miss C. M., The Training College, Keswick, Norwich	*Gen.*
1954	Johnson L. C., 36, Le Strange Close, Norwich	*F. W. Biol.*
1931	Johnston Mrs. F., Langley, Berkhamsted, Herts.	*Gen.*
1952	Johnston Dr. J. C., The Grange, Thornage, Holt, Norfolk	*Birds*
1952	Johnston Mrs. J. C., The Grange, Thornage, Holt, Norfolk	*Birds*
1885	Jones Sir Lawrence, BT., 39, Harrington Gardens, S.W.7.	*Gen.*
1946	Jones R., B.SC., 402, Unthank Road, Norwich	*Birds*
1939	Joy Mrs., Crabbetts, Hoveton St. John, Norwich	*Gen.*

K

1926	Keith E. C., Swanton Morley House, East Dereham	*Gen.*
1931	Ketton-Cremer R. W., Felbrigg Hall, Norfolk	*Gen.*
1953	Kirby P., "Midway," Woodland Drive, Thorpe End, Nch.	*Birds*
1949	Kyle Miss R. H., School House, Thurton, Norwich	*Gen.*

L

1952	*Lake Miss J., 17, Constitution Hill, Norwich	*Birds*
1943	Lambert Dr. J. M., West End Avenue, Brundall, Norwich	*P.*
1930	Lance Major H. W., Burnham Norton Lodge, King's Lynn	*Gen.*
1936	Larking R. C., 5, Mile End Road, Norwich	*Gen.*
1953	Lawrence K., 6, Tanner Street, Thetford	*Birds*
1953	Lawrence R. V., 77, Norwich Road, Thetford	*Birds*
1947	Layton D. A., Tudor House, Poplar Ave., Eaton, Norwich	*Birds*
1939	Leake Miss D. A., Plaxtole, Goodwin's Road, King's Lynn	*Gen.*
1953	Levell A. B., New Road, Shipdham, Thetford	*Gen.*
1953	Lewin Miss C. E., The Old Hall, Hethersett, Norwich	*P.*
1944	Libbey R. P., 143, Gaywood Road, King's Lynn	*P.*
1947	Lindqvist K., Drayton, Norwich	*Gen.*
1942	Lisney A. A., M.A., M.D., F.R.E.S., Dune Gate, Clarence Road, Dorchester, Dorset	*Ins.*
1946	Lloyd Major J. D., Warren Cottage, Euston, Thetford	*Gen.*
1922	Lloyd Major L. W., Taverham Mill, Norwich	*Birds*
1948	Lloyd Mrs. L. W., Taverham Mill, Norwich	*Birds*
1945	Lockett Colonel V., Framingham Pigot, Norwich	*Gen.*
1923	Long G. S. B., 18, The Crescent, Chapel Field Rd., Norwich	*Gen.*
1923	Long Mrs. G. V., The Spa Hotel, Woodhall Spa, Lincs.	*Gen.*
1946	Lyon K., C.B., C.B.E., The Old Barn, West Runton, Norfolk	*P.*

M

1924	Mackenzie Miss G., Hill House, Great Horkesley, Colchester, Essex	*Birds*
1931	Maidment Dr. F. N. H., Meadows, Harleston, Norfolk	*Birds*
1937	Maingay Mrs., The Mount, Aylsham, Norfolk	*Birds, P.*
1919	Mann Mrs. E. M., The Vicarage, Alford, Lincs.	*Gen.*
1931	Marshall E. H., Fiddler's Croft, Little Hadham, Much Hadham, Herts.	*Gen.*
1931	Marshall Capt. W. K., The Silver Hill, Radburne, Kirk Langley, Derbyshire	*Gen.*
1938	Marsham Rev. A. F., Hevingham Rectory, Norwich	*Gen.*
1946	Marsham Mrs., Stratton Strawless Rectory, Norwich	*Gen.*
1953	Marston Miss M. E., Wilcot, Stoke Holy Cross, Norwich	*Mam.*

Elected		
1912	Mason A., Guild House, Thorpe St. Andrew, Norwich	*Birds*
1952	Mason Mrs. G., Guild House, Thorpe St. Andrew, Norwich	*P.*
1893	†Mayfield A., F.L.S., Mendlesham, Stowmarket, Suffolk	*P.*
1945	*Mayhew Lady, Felthorpe Hall, Norwich	*Gen.*
1949	McClelland G. A. H., Appletree Cottage, Calbourne, Newport, Isle of Wight	*Ins.*
1948	McCulley Dr. W. J., St. Andrew's Hospital, Thorpe, Norwich	*Gen.*
1953	McDougall H., Cawston Manor, Norfolk	*Birds*
1950	McEwen L. M., 8, Stanmore Road, Thorpe, Norwich	*Gen.*
1933	McHardy Maj.-Gen. A. A., C.B., C.M.G., D.S.O., M.B.E., The Thatched Cottage, Hickling, Norwich	*Birds*
1945	McLean A. S., R.N., Humbletoft, East Dereham, Norfolk	*Birds*
1933	McLean C., Humbletoft, East Dereham, Norfolk	*Birds*
1945	McLean D. C. H., Humbletoft, East Dereham, Norfolk	*Birds*
1926	Meade Miss P., 4, Tenison Avenue, Cambridge	*Birds*
1926	Meiklejohn Mrs. R. F., Arcady, Cley, Holt, Norfolk	*Birds*
1945	Middleton W. H. H., Riverside, Costessey, Norwich	*Gen.*
1946	Mills J. W., 129, George Borrow Road, Norwich	*Gen.*
1923	Minns Mrs. H. C., Wings Place, Ditchling, Sussex	*Gen.*
1951	Moore C. E. J., 21, Camberley Road, Norwich	*Gen.*
1948	Moore R. A., 127, Cecil Road, Norwich	*Gen.*
1923	Moppes L. E. van, Tyle Mill, Sulhamstead, Berks.	*Gen.*
1946	*Morgan Dr. G. W., The Hall, Swindon Village nr. Cheltenham	*Gen.*
1949	Morton Dr. H. J. S., White Hart Cottage, Brinkley, nr. Newmarket, Cambs.	*Birds*
1946	Mosby Dr. J. F., Wymondham Training College, Norfolk	*Geol.*
1946	Moss Miss B., M.SC., Potter Heigham, Gt. Yarmouth	*Gen.*
1922	Mountfield Miss M., Horsford, Norwich	*Gen.*
1953	Mumford E. B., The White House, Keswick Road, Cringleford, Norwich	*Birds*
1921	*Murton Mrs. A. H., M.B.E., Cranbrook Lodge, Cranbrook, Kent	*Birds*
1950	Muskett F. E., 31, Rosary Road, Norwich	*Gen.*

N

1951	Nash Miss M. C., 8, Josephine Close, Norwich	*P.*
1953	Newnes M., Hill House, Tuesday Market Place, King's Lynn	*Birds*
1953	‡Nicholls G. W., 16, Portersfield Road, Norwich	*Birds*
1953	Nichols Miss M. E., 245, College Road, Norwich	*Birds*
1915	Nightingale S. R., The Grey House, Ormesby, Norfolk	*Gen.*
1939	Noble Miss E. R., White House, Saham Toney, Thetford	*P.*
1953	Notley A. T., Fishley Place, Acle, Norfolk	*P.*

O

1949	*Oldfield G., 8, Albermarle Road, Norwich	*Gen.*
1952	Orgill Mrs. E., Grey Gables, Cawston, Norfolk	*Birds*
1950	Osborne Miss K. E., 4, Gould Road, Norwich	*Gen.*

P

1949	Page F. J. Taylor, B.SC., 77, Surrey Street, Norwich	*Mam., F. W. Biol., Birds*
1952	*Page P. R., Mill Farm, Felthorpe, Norwich	*P., Geol.*
1949	Palmer A. R. M., The Manor House, Newton St. Faiths, Norwich	*Birds, Ins.*
1948	Palmer B. L., Weybourne, Holt, Norfolk	*Gen.*
1946	Palmer Miss D. G., 20, Grange Road, Norwich	*P.*

Elected		
1919	*Palmer Mrs. P. Hurry, 25, North Drive, Great Yarmouth	*Birds*
1950	Palmer P., 40, Furze Road, Thorpe, Norwich	*Gen.*
1953	Palmer Dr. S., Beechurst, East Dereham	*Gen.*
1952	‡Pankhurst J. S. R., Roxana, Toftwood, East Dereham	*P.*
1932	Patteson Miss C. E., Gt. Hautbois House, Coltishall, Norfolk	*Gen.*
1945	Paulson C. W. G., Wyresdale How, Pendleton Road, Redhill, Surrey	*Gen.*
1911	*Payler D., 29, Anderton Park Rd , Moseley, Birmingh'm 13	*Gen.*
1952	Payne J. P. H., Breynton House, Bawdeswell, E. Dereham	*Birds, P.*
1952	Payne T. P. H., Breynton House, Bawdeswell, E. Dereham	*Gen.*
1950	Peake J. F., 17, Tillett Road, Norwich	*Birds*
1953	Pennington Miss J. B., 22, Mill Hill Road, Norwich	*P.*
1953	Pennington Miss M., Glaven Cot., Wiveton, Holt, Norfolk	*P.*
1926	Percy Lord William, C.B.E., D.S.O., Horstead Hall, Norfolk	*Birds*
1946	*Pfob Mrs. A. Martin, Hill House, Little Melton, Norwich	*Gen.*
1926	Phillippo G., Church House, Sibsey, Boston, Lincs.	*Birds*
1949	Phillips H. A. P., Ivy Dene, Beeston Common, Sheringham	*Gen.*
1930	Podmore R. E., " Maynards," Matfield, Kent	*Birds*
1939	Poortvliet Mrs. J. van, The Beeches, Stratton Strawless, Norwich	*P.*
1944	Porter W. A., 14, Stokes Avenue, Brandon Road, Watton	*Gen.*
1949	Potts T. A., La Chaumiere, West Runton, Norfolk	*Gen.*
1953	Powell Mrs. V., Harbour Cottage, Brancaster Staithe, Nfk.	*P., Birds*
1953	Prescott Rev. A., The Rectory, Claxton, Norwich	*Ins.*
1952	Preston Mrs. Currie, 73, Mill Hill Road, Norwich	*Birds, M. Biol.*
1949	Prosser R. J., c/o 44 Aerodrome Crescent, Thorpe-next-Nch.	*P.*
1948	Prosser S. T., 44, Aerodrome Crescent, Thorpe-next-Nch.	*Gen.*
1950	Punter D., " Woodlands," Holt, Norfolk	*Birds, M. Biol.*
1913	Purdy T. W., Woodgate, Aylsham, Norfolk	*P.*

R

1953	Rae R. J., 67, St. Leonard's Road, Norwich	*Birds*
1929	Rait-Kerr Mrs. R. S., Paddocks, Copperkins Lane, Amersham, Bucks.	*Gen.*
1929	Ramage H. P., Thatched House, Holt, Norfolk	*Gen.*
1928	Raywood W., Honingham Thorpe, Norwich	*Gen.*
1953	Read Miss G. E., Lime Kiln Farm, Newton Flotman, Norwich	*Ins.*
1949	Read T. E., Whyte Gates, Deopham, Norwich	*Birds, Mam.*
1945	Renshaw Sir Stephen, Great Fransham, East Dereham	*Gen.*
1946	*Ribbons B. W., B.SC., A.L.S., 28, Boundary Road, Norwich	*P.*
1945	Richardson R. A., c/o Mrs. Davison, Hill Top, Cley, Norfolk	*Birds*
1950	‡Riley H., Great Moulton, Norwich	*P., Ins.*
1924	Ripplingall N. F., Langham, Holt, Norfolk	*Gen.*
1945	Rix A., 4, Intwood Road, Cringleford, Norwich	*Gen.*
1941	Roberts Sir S., Cockley Cley Hall, Swaffham, Norfolk	*Gen.*
1953	Robson P. M., 43, Pettus Road, Norwich	*P.*
1946	Rounce J. N., The Croft, Great Walsingham, Norfolk	*Gen.*
1953	Rowland Miss H. M., 19, Alder Road, Folkestone, Kent	*Birds*
1902	Ruggles-Brise Mrs. C. j., M.B.E., Tilbury Hall, Great Yeldham, Essex	*Gen.*
1906	Rumbelow P. E., 27, Rodney Road, Gt. Yarmouth	*P., F. W. Biol.*
1953	Ruthven D. J., 149, North Walsham Road, Sprowston, Nch.	*Ins.*

S

1948	Sainty J. E., The Hedges, Cromer Rd., West Runton, Nfk.	*Geol.*
1931	*Salisbury Sir Edward, F.L.S., F.R.S., Director, Royal Botanic Gardens, Kew, Surrey	*P.*

Elected		
1952	Sandall M. A., 226, Jex Road, Norwich	*Ins.*
1936	Sargent C. G., Morningthorpe Manor, Long Stratton, Norfolk	*Gen.*
1945	Savory A., Riverdale, Brundall, Norwich	*Mam., Birds*
1937	Sawbridge Admiral, Thrigby Hall, Great Yarmouth	*Gen.*
1951	Scoones Miss C. E., Bank House, Jetty Street, Cromer	*M. Biol.*
1937	Scott Mrs. H. M., 54, The Close, Norwich	*Birds*
1954	Scott R., Field House Farm, Binham, Fakenham, Norfolk	*Gen.*
1953	‡Scott R. R., Rickinghall, nr. Diss, Norfolk	*Birds, P., Ins., Mam.*
1943	Seago M. J., 33, Acacia Road, Thorpe, Norwich	*Birds*
1953	Seaman Miss M. E., 71, Ketts Hill, Norwich	*Birds*
1950	Segger Miss K. E., West View, St. Leonard's Rd., Norwich	*Gen.*
1949	Self K. W., 53, Brian Avenue, Norwich	*Birds*
1951	Sewell R. H., 1, Brickyard, Surlingham, Norfolk	*Gen.*
1922	Shepheard Dr. S., Abbott's Hall, Aylsham, Norfolk	*Mam.*
1946	Silverwood J. H., Garfield, Great Plumstead, Norfolk	*Gen.*
1948	Simon P. H., Benvane, High Kelling, Holt, Norfolk	*P.*
1947	Sistern R. D., Flat 2, 107, Newmarket Road, Norwich	*Birds*
1953	Skinner Miss U., Hazeldene, 4, Christchurch Road, Norwich	*Birds, P.*
1950	Smith C., Attlebridge, Norwich	*Gen.*
1915	Smith Mrs. C., Ellingham Hall, Bungay, Suffolk	*Gen.*
1953	Smith Miss D. E., 377a, Unthank Road, Norwich	*Birds, Mam.*
1953	Smith E. J., Prospect Farm, via Earsham, Bungay, Suffolk	*Gen.*
1950	Smith M. E., Attlebridge, Norwich	*Gen.*
1953	‡Somerville S. E., 69, Charles Ave., Thunder Lane, Norwich	*Birds*
1953	Spinks Miss W., 38, Newtown, Thetford	*Ins., Birds, Mam.*
1923	Spurrell Miss M., The Bath House, Ditchingham, Norfolk	*Birds*
1923	Spurrell Miss P., The Manor House, Newton St. Faiths, Nch.	*Gen.*
1935	Squirrell Monsignor Canon H. S., The Lodge, Poringland, Norwich	*Gen.*
1943	Steele H. C., " Everglade," Strumpshaw, Norfolk	*Gen.*
1925	Steers Prof. J. A., M.A., Department of Geography, Downing Place, Cambridge	*Geol.*
1947	Steward D., The Grange, New Buckenham, Norfolk	*Gen.*
1921	Stimpson E., Sall Moor Hall, Reepham, Norfolk	*Gen.*
1946	Stuart A., The Red House, Stoke Holy Cross, Norwich	*Gen.*
1896	Sutton W. Lincoln, Framingham Pigot, Norwich	*Gen.*
1938	Swann E. L., 282, Wootton Road, King's Lynn	*P.*

T

1953	Taylor Mrs. A. W., 1, Trinity Street, Norwich	*Gen.*
1935	Taylor G. B., 7, Candover Close, Harmondsworth, West Drayton, Middlesex	*Ins.*
1938	Taylor R. Sunderland, Culpho End, nr. Ipswich	*Gen.*
1938	Taylor Mrs. R. Sunderland, Culpho End, nr. Ipswich	*Gen.*
1945	Templewood The Rt. Hon. The Viscount, Templewood House, Cromer	*Birds*
935	Thomas J. M. Ridley, 3, Christchurch Road, Norwich	*Gen.*
954	Thorn Miss A. J., 63, Greenway, Fakenham, Norfolk	*P.*
953	Thurrell R. G., The Firs, Hempnall, Norfolk	*Geol.*
951	Ticehurst Dr. R. G., " Pevensey," The Buttlands, Wells, Nfk.	*Birds*
954	Timbers J. E., 56, Sherbourne Place, King Street, Norwich	*Gen.*
933	Tindall Miss E., Woodlands, Thorpe, Norwich	*Gen.*
946	Todd R. G., Wells, Norfolk	*Gen.*
953	Tracey Miss J., 50, Cotman Road, Norwich	*P.*
954	Trafford Mrs. S. W., Wroxham Hall, Norwich	*Gen.*
948	Trichett J. S., 7, Bluebell Road, Eaton, Norwich	*Gen.*
942	*Turner A. H., F.R.E.S., F.R.MET. SOC., Forest Drove, Bickenhall, Hatch Beauchamp, Taunton, Somerset	*Ins.*

Elected		
1950	Turner R. W., 13, Church Street, Barford, Norfolk	*Gen.*
1947	Tusting Miss J. M., Home Close, Cringleford, Norwich	*Gen.*
1946	Tydeman Miss M., Dial Farm, Coddenham, Ipswich, Suffolk	*Gen.*

U

1951	Unthank Miss M. B., Mill House, Mundham, Loddon, Nch.	*Birds, P.*
1921	Upcher Sir Henry, Sheringham Hall, Norfolk	*Gen.*
1945	Uridge H., "Carlekempe," East Parade, Bexhill-on-Sea, Sussex	*Birds*
1945	Uridge Mrs. H., "Carlekempe," East Parade, Bexhill-on-Sea, Sussex	*Birds*

V

1949	Vaughan J., Woodlands, Holt, Norfolk	*Gen.*

W

1936	Wade Miss O. M., Maid's Head, Yoxford, Saxmundham, Suffolk	*P.*
1923	Walter Mrs. O. T., Tacolneston Hall, Norfolk	*Birds, P., Ins., Mam.*
1949	Wanstall Mrs. P. J., Dytchleys, Coxtie Green, Brentwood, Essex	*Ins.*
1947	Warburg J. W., The Old Rectory, Edingthorpe, N. Walsham	
1954	Ward C. W., 3, Buxton Villas, North Walsham, Norfolk	*P.*
1948	Ward Miss F. O., 13, Ipswich Road, Norwich	*Ins., Birds*
1946	Warren A. J., 175, Colman Road, Norwich	*Ins.*
1923	Waterfield Mrs. W., Snape, Saxmundham, Suffolk	*Ins., P.*
1953	Watling D., 270, Bluebell Road, Norwich	*P.*
1947	Watson C. H., Quartley House, Holt, Norfolk	*Gen.*
1947	Watt K., Burnley Hall, Somerton, Great Yarmouth	*Gen.*
1947	Watt Mrs. K., Burnley Hall, Somerton, Great Yarmouth	*Gen.*
1932	Watt Mrs. N. M., The Gables, South Wootton, King's Lynn	*P., Birds*
1932	Wayne Mrs. E., Colkirk House, Fakenham, Norfolk	*Birds*
1953	Webb Miss M., 2, Josephine Close, Norwich	*P.*
1949	Weston Miss B. M., Uplands, Framingham Pigot, Norwich	*Gen.*
1946	Weston Miss F. M., 1, Muriel Road, Christchurch Rd., Nch.	*Gen.*
1952	Wheeler Miss J. P., 41b, All Saints Green, Norwich	*P., Birds*
1932	‡Wheeler E. G. Capt. S. G., R.N., The Pheasanteries, Edingthorpe, North Walsham, Norfolk	*Birds*
1936	Whitaker S., M.B.O.U., 36, Belper Road, Derby	*Birds*
1937	Whitehead Dr. F. E., C.B.E., M.R.C.S., "The Elms," 112, Victoria Road, Oulton Broad, Lowestoft	*Gen.*
1947	Whittaker Dr. E. M., 159, Christchurch Road, Norwich	*Birds*
1954	Wilde A. J., "Rodney," Broomhill, Downham Market, Nfk.	*Birds*
1947	Wiles Miss W. P., Brook House, Stratton Strawless, Norwich	*Gen., Geol.*
1945	*Wilson Capt. C. B., Irstead Lodge, Neatishead, Norfolk	*Gen.*
1954	Wilson Miss M. E., The Carpenter's Shop, Somerleyton, Suffolk	*P.*
1944	*Wiltshire E. P., B.A., F.R.E.S., c/o Foreign Office, London, S.W.2.	*Ins.*
1945	Winter J. W., Thorpe Cottage, Hemingford Grey, Huntingdonshire	*Birds*
1952	Woolley Miss S. M., 12, Patricia Road, Norwich	*P., F. W. Biol.*
1922	Wortley F., Half Year, West Runton, Norfolk	*Gen.*
1951	Wyatt T. C., 22, Chaucer Road, Cambridge	*Birds*

Affiliated Organisations and Schools :

Elected

1952	The Blyth School, St. Clement's Hill, Norwich
1938	The British Empire Naturalists' Association, c/o Reculvers, Nelson Road, Sheringham
1952	City of Norwich School, Eaton Road, Norwich
1918	Gresham's School, Holt, Norfolk
1953	The Norwich Paramoudra Club *Hon. Secretary :* A. Martin, 73, Brian Avenue, Norwich
1915	The Public Library, Norwich
1915	The Public Library, Yarmouth
1926	Norfolk and Norwich Library
1953	The Norwich School, The Close, Norwich
1952	Notre Dame High School, Surrey Street, Norwich
1953	Rockland St. Mary's School, Norfolk
1952	Town Close Preparatory School, Ipswich Road, Norwich
1953	County Primary School, Watton, Norfolk

Deaths during the year (on information received) :

1946	Brooks A. B., Haynes Green, Layer Mainey, Essex	April, 1954
1924	Chittock Mr. & Mrs. A. T., 12, Chapel Field North, Norwich	December, 1953
1945	Coke Mrs. R. R., Oaklands, North Street, Sheringham	August, 1952
1906	*Hamond Major P., D.S.O., Morston, Holt, Norfolk	August, 1953
1949	Lund Dr. K., Cowper Cottage, Mundesley, Norfolk	1953
1908	†Riviere B. B., Salhouse Lodge, Norwich	December, 1953

Total 6

Resignations and Lapsed Membership :

Total 15

New Members During 1953 :

Total 52

Total Membership (counting all affiliated organisations as 1 member each) :

Norwich	221
Outer Norfolk	154
Ex-County	86
Total	461

Publications received from other Societies and Institutions.

Belgium : Le Gerfaut.

Birmingham : Natural History & Philosophical Society.

British Association for the Advancement of Science.

Canada : Nova Scotian Institute of Science.

Cambridge Bird Club.

Cambridge Philosophical Society (Biological Reviews).

Croydon Natural History & Scientific Society.

Denmark : Skallig-Laboratoriet.

Edinburgh : Botanical Society.
Geological Society.
Royal Society.

Essex Field Club.

Freshwater Biological Association.

Glasgow & Andersonian Natural History & Microscopical Soc.

Gresham's School Natural History Society.

Hertfordshire Natural History Society & Field Club.

Holland : Archives Néerlandaises de Zoologie.

Linnean Society of London (Proceedings).

London Natural History Society.

Manchester Literary & Philosophical Society.

Marine Biological Association.

New Zealand : Royal Society.

North Staffs Field Club.

Northumberland, Durham and Newcastle N.H.S.

Royal Institution of Great Britain.

Royal Microscopical Society.

Suffolk Naturalists' Society.

Sweden : Acta Phytogeographica Suecica.

Sweden : Royal Physiographic Society at Lund.

U.S.A. : California University (Zoology).
Connecticut Academy of Arts & Sciences.
Harvard College (Zoology)
New York Academy of Sciences.
Philadelphia Academy of Natural Sciences.
Wisconsin Academy of Sciences, Arts & Letters.

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