TRANSACTIONS

OF THE

Norfolk and Norwich

NATURALISTS' SOCIETY

FOR THE YEAR

1938

VOL. XIV. PART IV.

EDITED BY MAJOR A. BUXTON

NORWICH

PRINTED BY A. E. SOMAN & CO., LTD.

MARCH, 1939

PRICE 10/-

NORFOLK & NORWICH NATURALISTS' SOCIETY

Law Revised at the 69th Annual Meeting on April 19th, 1938

Section III, 3, to the officers of the Society shall be added, after "President" a "President-elect," and *Section VI.*, 2, to read "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 in, or repeal of existing Laws, passed at the Annual Meeting shall at once come into operation."

PAST PRESIDENTS

REV. JOSEPH CROMPTON, M.A.	1869—70
„ „ „	1870—71
HENRY STEVENSON, F.L.S.	1871—72
MICHAEL BEVERLEY, M.D.	1872—73
FREDERIC KITTON, Hon. F.R.M.S.	1873—74
H. D. GELDART	1874—75
JOHN B. BRIDGMAN	1875—76
T. G. BAYFIELD	1876—77
F. W. HARMER, F.G.S.	1877—78
„ „ „	1878—79
THOMAS SOUTHWELL, F.Z.S.	1879—80
OCTAVIUS CORDER	1880—81
J. H. GURNEY, Jun., F.Z.S.	1881—82
H. D. GELDART	1882—83
H. M. UPCHER, F.Z.S.	1883—84
FRANCIS SUTTON, F.C.S.	1884—85
MAJOR H. W. FEILDEN, C.B., F.G.S., C.M.Z.S.	1885—86
SIR PETER EADE, M.D., F.R.C.P.	1886—87
SIR EDWARD NEWTON, K.C.M.G., F.L.S., C.M.Z.S.	1887—88
J. H. GURNEY, F.L.S., F.Z.S.	1888—89
SHEPHARD T TAYLOR, M.B.	1889—90
HENRY SEEBOHM, F.L.S., F.Z.S.	1890—91
F. D. WHEELER, M.A., LL.D.	1891—92
HORACE B WOODWARD, F.G.S.	1892—93
THOMAS SOUTHWELL, F.Z.S.	1893—94
C. B. PLOWRIGHT, M.D.	1894—95
H. D. GELDART	1895—96
SIR F. C. M. BOILEAU, Bart., F.Z.S., F.S.A.	1896—97
A. W. PRESTON, F.R.Met.Soc.	1897—98
J. H GURNEY, F.L.S., F.Z.S.	1898—99
JOHN T. HOTBLACK	1899—1900
SIDNEY F. HARMER, Sc.D., F.R.S.	1900—01
W. H. BIDWELL	1901—02
HENRY WOODWARD, LL.D., F.R.S., V.P.Z.S., F.G.S.	1902—03
FREDERICK LONG, L.R.C.P.	1903—04
WALTER GARSTANG, M.A.	1904—05
EUSTACE GURNEY, M.A., F.Z.S.	1905—06
C. A. HAMOND	1906—07
SYDNEY H. LONG, M.D., M.B.O.U.	1907—08
REV. M. C. H. BIRD, M.A., M.B.O.U.	1908—09
D. G THOMSON, M.D.	1909—10
W. M. CROWFOOT, F.R.C.S.	1910—11
W. LINCOLNE SUTTON, F.I.C.	1911—12
ROBERT GURNEY, M.A., F.Z.S.	1912—13
MISS ALICE M. GELDART	1913—14
J. H. F. WALTER, F.Z.S.	1914—15
H. J. THOULESS	1915—16
CLAUDE B. TICEHURST, M.A., M.B.O.U.	1916—17
W. G. CLARKE, F.G.S.	1917—18
EDWARD BIDWELL	1918—19
J. H. GURNEY, F.L.S., F.Z.S.	1919—20
B. B. RIVIERE, F.R.C.S., M.B.O.U.	1920—21
MISS E. L. TURNER, F.L.S., F.Z.S.	1921—22
RUSSELL J. COLMAN	1922—23
SIR HUGH R. BEEVOR, Bart.	1923—24
DONALD HUTCHINSON, M.D.	1924—25
E. H. HANKIN, M.A., Sc.D.	1925—26
„ „ „	1926—27
H. J. HOWARD, F.L.S.	1927—28
H. F. WITHERBY, F.Z.S., M.B.O.U.	1928—29
G. H. GURNEY, F.E.S., F.Z.S., M.B.O.U.	1929—30
MISS A. M. GELDART	1930—31
E. J. SALISBURY, D.Sc., F.L.S.	1931—32
MAJOR A. BUXTON, D.S.O., M.B.O.U.	1932—33
„ „ „ „	1933—34
W. P. PYCRAFT, F.L.S., F.Z.S.	1934—35
COLIN McLEAN	1935—36
G. J. COOKE	1936—37
MISS J. M. FERRIER, F.Z.S., M.B.O.U.,	1937—38

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MARCH, 1939

Norfolk and Norwich Naturalists' Society

Patron
H.M THE KING

OFFICERS FOR 1938

President
E. T. BOARDMAN.

Vice-Presidents
THE RIGHT HON. THE EARL OF LEICESTER, G.C.V.O., C.M.G.
SIR SIDNEY F. HARMER, K.B.E., Sc.D., F.R.S. PROF. F. W. OLIVER, D.Sc., F.R.S.
RUSSELL J. COLMAN. ROBERT GURNEY, M.A., D.Sc., F.L.S
SYDNEY H. LONG, M.D., F.Z.S., M.B.O.U.

Hon. Treasurer
F. C. HINDE
16, West Parade, Norwich

Hon. Secretary
H. W. BACK
Hethersett Hall, Norwich

Assistant Secretary & Hon. Librarian
E. A. ELLIS
Castle Museum, Norwich

Hon. Secretary, Junior Branch
MISS P. MEADE
Quidenham, Norwich

Hon. Editor
MAJOR A. BUXTON

Hon. Auditor
C. R. A. HAMMOND

Committee
SYDNEY H. LONG (Chairman)

MISS J. M. FERRIER	MISS G. V. BARNARD	MRS. RONALD MEICKLEJOHN
DR. G. E. DEACON	MISS A. M. GELDART	W. C. EASTER
H. J. HOWARD	E. T. DANIELS	G. J. COOKE
(to retire 1941)	(to retire 1940)	(to retire 1939)

LIST OF MEMBERS, DEC., 1938

Members who have compounded for their Subscriptions are marked with an asterisk

Elected

A

1919 Adcock E. A., 4, Judges Walk, Norwich
1936 Alston G., Lyngate House, Worstead
1925 Anderson Dr. T., 386a, Unthank Road, Norwich
1895 Andrews W. H. M., Ashby Lodge, Ashby St. Mary, Norwich
1936 Andrews Mrs. G., The Old Hall, Hethersett
1937 Andrews Miss B., The Old Hall, Hethersett
1883 Aplin O. V., Stonehill, Bloxham, Oxon
1912 Astley Major D. G., Wroxham, Norwich

B

1922 Back C. W., The Lodge, Colney Road, Cringleford
1919 Back H. W., (*Hon. Sec.*), Hethersett Hall, Norwich
1935 Back Mrs. H. W., Hethersett Hall, Norwich
1933 Bacon Edmund, Raveningham Hall, Norfolk
1923 Bagnell Mrs., 21, Catton Grove, Norwich
1938 Bagnell Miss H. D., 21, Catton Grove, Norwich
1921 *Baker E. C. Stuart, O.B.E., F.Z.S., 6, Harold Road, Upper Norwood, S.E. 19.
1923 Ball Dr. C. R. H., Minna Lodge, The Green, Hunstanton
1919 Barclay Colonel H. A., Hanworth Hall, Norwich
1922 Meicklejohn Mrs. Ronald, Hanworth Hall, Norwich
1924 Barnard G. W., 4, Surrey Street, Norwich
1921 Barnard Miss G. V., Castle Museum, Norwich
1927 Barnard Mrs., The Clyffe, St. Leonard's Road, Norwich
1933 Barne Mrs., The Malting, Garboldisham, Diss, Norfolk
1937 Barrett John A., The Lodge, Cringleford, Norwich
1927 *Barrington F. F., University Coll: Hosp: Medical School, London, W.C.1.
1921 Barrow Miss E. J., The Red House, Drayton, Norwich
1937 Barry Miss, Gt. Witchingham Hall, Norfolk
1922 Bedwell E.C., "Bruggen," Brighton Road, Coulsdon, Surrey
1912 Beevor Sir H., Bart., Hargham Hall, Norfolk
1934 *Bennett W. W., Swanton Morley, E. Dereham
1921 *Berney F. L., R.A.O.U., Barcarolle, Longreach, Queensland
1933 Besant Col. W. H., Grove House, Worstead
1925 Best Miss M. G., F.Z.S., M.B.O.U., Broadwater, Amport, Andover
1931 Bickersteth R. L., Casterton Hall, Kirby Lonsdale, Yorks.
1921 Bignold Sir C. R., Loddon House, Loddon, Norfolk
1901 Birkbeck H. A., King's Lynn
1921 Birkbeck Col: Oliver, Little Massingham House, King's Lynn
1933 Blackburne C. I., Weydown Hatch, Haslemere, Surrey
1930 Blake Mrs., The Red House, Bradestone, Norwich
1931 Blake H., Broadland House, 22, Newgate Street, London, E.C.1.
1925 Blofeld T. C., Hoveton House, Norwich
1936 Blofeld Mrs., Hoveton House, Norwich
1885 Boardman E. T., (*President*), How Hill, Ludham, Norfolk
1938 Boardman, M. R., Howe Hill, Ludham
1936 Bolingbroke Miss C., Ferryside, Riverside Road, Norwich
1924 Boyd A. W., Frandley House, Near Northwich, Cheshire

Elected.

1915 Bradfer-Laurence H. L., F.S.A., Grantley Grange, Ripon, Yorks.
1923 Brereton Mrs., Gresham, Norwich
1931 Bridgman Miss J. W., B.Sc., Blyth Secondary School, Norwich
1937 Bright J. A., High School for Boys, St. Giles' Gates, Norwich
1938 British Empire Naturalists' Association, C/o. Miss Heward, "O'Fids," Hall Road, Cromer
1912 Brooks J. R., North Walsham Wood, Norwich
1925 Brooks Mrs., North Walsham Wood
1934 Brooks C. J., "Rest Harrow," Horning, Norwich
1935 Brun H. C., Kennel House, Weasenham St. Peter, Norfolk
1921 Bruton M. S., Norfolk House, Aylsham
1925 Bryan H., "Lanthwaite," Eaton, Norwich
1930 Brydone R. M., F.G.S., Ivy Farm House, Mundesley
1926 Bullard Ernest, Rose Cottage, Horning
1926 Bullard, E. J., Hellesdon House, Norwich
1925 Bulwer Mrs., Heydon Grange, Norwich
1936 Bulwer Miss R. M., Dower House, Heydon
1923 Burton Arthur, M.D., Cromer
1923 Burton Mrs. Arthur, Cromer
1929 Burton Miss T., 137, Newmarket Road, Norwich
1936 Burton Miss F. W., Harford Manor, Norwich
1928 Bushell Maurice D., Bolwick, Marsham, Norwich
1921 *Buxton Major Anthony, D.S.O., Horsey Hall, Norfolk
1884 Buxton A. F., Fairhill, Tonbridge, Kent
1923 *Buxton Major Ivor, Little Dunham, King's Lynn
1906 Buxton R. G., Petygards, Sporle, King's Lynn, Norfolk
1906 Buxton W. L., Bolwick Hall, Marsham, Norwich

C

1932 Caffyn D. E., Keymer, 3, Evesham Road, Reigate, Surrey
1909 Calvert E. M., Eaton, Norwich
1923 Carruthers Douglas, Barmer Hall, King's Lynn
1907 Caton Rev. R. B., The Old Rectory, Little Fakenham, Thetford
1902 Cator John, Woodbastwick Hall, Norfolk
1923 Cator Capt. H. J., Ranworth Old Hall, Norwich
1926 Chadwick Dr. M., 3, King Street, King's Lynn
1911 Chamberlin Rev. C. M., Witton Rectory, Norwich
1933 Chapman Hon. Mrs., Barford Old Hall, Norwich
1919 *Chasen F. N., The Raffles Museum, Singapore
1924 Chittock A. T., 12, Chapel Field North, Norwich
1924 Chittock Mrs. A. T., 12 Chapel Field North, Norwich
1907 Christie J. A., M P., Framingham Manor, Norwich
1937 Claridge Mrs. V., St. William's House, Plumstead Road, Norwich
1927 Clarke Miss L. R 12, St. Philip's Road, Norwich
1937 Clayton Oswald, Framingham Pigot, Norwich
1932 Clogstoun H. P. S., M.B.E., Buntingsdale Hall, Market Drayton, Salop
1934 Cockle M. J. D., Wheatfen Broad, Surlingham, Norwich
1909 Coke Right Hon. Viscount, Sowley, Lymington
1923 Cole Lowry A. C., The Lodge, Sprowston
1923 Cole Mrs. Lowry, The Lodge, Sprowston
1924 Collings Dr. D. W., The Mount, Southwold
1903 *Colman Miss E. M., Carrow Abbey, Norwich
1903 *Colman Miss H. C., Carrow Abbey, Norwich
1881 Colman Russell J., *Lord Lieutenant, V.P.*, Crown Point, Norwich

Elected.

1925 Cooke G. J., 143, Newmarket Road, Norwich
1935 Cooke Mrs. G. J., 143, Newmarket Road, Norwich
1925 Copeman T. D., 215, Unthank Road, Norwich
1937 Corbett E. M., Royal Norfolk and Suffolk Yacht Club, Lowestoft
1921 Cozens-Hardy A., Oak Lodge, Sprowston, Norwich
1926 Cozens-Hardy E. W., Oak Lodge, Sprowston
1935 Cozens-Hardy Miss, Oak Lodge, Sprowston, Norwich
1886 Cross J. M., Wayside, Acle

D

1910 Dalby Rev. Alan, M.A., 7, South Parks Road, Oxford
1922 Dallas Chas. C., Eastley Wootton, New Milton, Hants.
1928 Daniels E. T., 31, Market Place, Norwich
1923 Daukes Maj. A. H., Thursley, Godalming
1914 Davies H. C., Caistor Old Hall, Norwich
1917 Deacon G. E., Brundall, Norwich
1936 Dewhurst J. E., Riverside House, Reedham
1938 Diggle J. M., 4, Church Avenue, Christchurch Road, Norwich
1938 Duff Miss, The Training College, Norwich

E

1911 Easter W. C., 99, City Road, Norwich
1929 Ellis Edward A., *Hon. Librarian*, 1, Mount Park, Long John Hill, Old Lakenham, Norwich
1938 Ellis Mrs. E. A., 1, Mount Park, Long John Hill, Old Lakenham, Norwich
1936 Ellis M. B., 17, Mountfield Avenue, Upper Hellesdon, Norwich
1930 Elwes Miss H., The Paddox, Grimston, King's Lynn
1934 Emmett A., Barclays Bank, Bank Plain, Norwich
1919 Evans-Lombe Major E., Marlingford Hall, Norwich
1932 Evans-Lombe Mrs., Marlingford Hall, Norwich

F

1885 Falcon Michael, Sprowston Hall, Norfolk
1936 Farrell Miss E. M., 6, Mount Pleasant, Norwich
1927 Fawkes, Dr. R. B., Rede's House, Cromer
1922 *Ferrier Miss J. M., F.Z.S., M.B.O.U., Blakeney Downs, Blakeney, Norfolk
1937 Ferrier R. G., Hemsby Hall, Norfolk
1930 Finch Mrs. Alfred, Berry's Hall, Honingham, Norwich
1936 Finch C. H., Costessey House, Norwich
1924 Fisher K., Ph.D., The School, Oundle, Northants
1880 *Fletcher W. H. B., Aldwick Manor, Bognor
1931 Foster Capt. T. H., R.N., The Lodge, West Pottergate, Norwich,
1922 Frere Sir Bartle H. T., Mangreen Hall, Norfolk

G

1927 Garnett R. M., Whitby Gate, Thornton-le-dale, Pickering, Yorks.
1924 Gay Miss Ellen, Thurning Hall, Guist, Norfolk

Elected

1927 Gay Miss C. E., 59, Newmarket Road, Norwich
1926 Gayner J. S., Hall Cottage, New Earswick, York
1903 Geldart Miss Alice M., 2, Cotman Road, Norwich
1928 George Sydney S., Saham Toney, Thetford
1930 George F. Gordon, Seamere, Hingham, Norfolk
1931 Gibson Capt. C. M., R.N., Roughton, Norfolk
1933 Gibson Mrs., Roughton, Norfolk
1935 Gifford A., Ashby St. Mary, Norwich
1908 Gilbert R. T. E., Ashby Hall, Norfolk
1931 Gilbert Mrs. R. T. E., Ashby Hall, Norfolk
1921 Glover T., 224, Unthank Road, Norwich
1935 Glover Mrs., 224, Unthank Road, Norwich
1935 Goddard W. N., 187, Drayton Road, Norwich
1901 Goose A. W., 185, Earlham Road, Norwich
1937 Gould R. Pearce, Lime Tree House, Lime Tree Road, Norwich
1919 Greatorex H. A., Witton, Norwich
1924 Green Maj. E. A. Lycett, Ken Hill, Snettisham, Norfolk
1938 Green Miss I., 27, Grove Walk, Norwich
1918 Gresham School The, Holt, Norfolk
1929 Gurney John, Walsingham Abbey, Norfolk
1901 Gurney Q. E., Bawdeswell Hall, Norfolk
1894 *Gurney Robert, M.A., D.Sc., F.L.S., *F.P.*, Bayworth Corner, Boars Hill, Oxford
1918 Gurney Mrs. Robert, Bayworth Corner, Boars Hill, Oxford
1933 Gurney Miss Catharine, Houghton-in-the-Dale, Walsingham, Norfolk
1933 Gurney Miss Elizabeth, Walsingham Abbey, Norfolk
1932 Gurney Miss Evelyn, Bawdeswell Hall, Norwich

H

1892 *Haigh G. H. Caton, Grainsby Hall, Great Grimsby
1932 Hall J. E., The Highlands, Bressingham, Diss, Norfolk
1926 Hammond C. R. A., Sprowston Grange, Norwich
1932 Hamond A., c/o Barclays Bank, Norwich
1906 *Hamond Major Philip, D.S.O., Morston, Holt, Norfolk
1929 Hamond Commander, C. E., R.N., Myrtle Cottage, Porchester, Hants.
1932 Harbord The Hon. Doris, Harbord House, Cromer
1928 Hardinge Lt.-Col. T. S. N., D.S.O., Flaxmoor, Caston, Attleboro'
1934 Hardinge Mrs., Flaxmoor, Caston, Attleboro'
1908 Harker William, Blofield Hall, Norwich
1923 Harmer Russell T., The Grange, Rackheath, Norwich
1881 *Harmer Sir Sidney, K.B.E., F.R.S., *F.P.*, The Old Manor House, Melbourn, near Royston, Herts.
1906 Harris Rev. G. H., South View, Pier Avenue, Southwold, Suffolk
1923 Hastings Lord, Melton Constable Park, Norfolk
1928 Hendy E. W., Holt Anstiss, Porlock, Somerset
1925 Hewitt H. Dixon, F.I.C., 37, Earls St., Thetford
1925 Heywood R., Pentney House, Narborough, Norfolk
1919 Hinde Dr. E. B., 31, Mount Pleasant, Norwich
1891 Hinde F. C., *Hon. Treasurer*, 16, West Parade, Norwich
1923 Hines E. S., Heigham Grove, Norwich
1915 Hitchcock Arthur, Tamworth House, Tennyson Road, King's Lynn
1937 Hollingsworth P. C., Langham, Blakeney, Norfolk
1937 Hollingsworth Mrs., Langham, Blakeney, Norfolk

Elected

1923 Hoskins Maj. Gen. Sir Reginald, Ashridge House, Berkhamsted, Herts.
1919 Howard H. J., F.L.S., 6, College Road, Norwich
1926 Howlett Dr. J. K., The Beeches East Dereham, Norfolk
1930 Hudd Miss W. F., 55, Bethel Street, Norwich
1923 Hunter H. M., Mattishall Hall, East Dereham
1931 Hulse Mrs. M. W., Park House, Bromham, Beds.
1931 Hulse Miss E. M., Park House, Bromham, Beds.
1899 Hurrell H , 60, Albany Road, Great Yarmouth

I

1937 Imrie J. D. C., 11, Branksome Road, Norwich

J

1935 Jane F. W., B.Sc., Ph.D., F.L.S., Wyngarth, Radlett Road, Boreham Wood, Herts.
1937 Jarrold H. J., Braemar, Cotman Road, Norwich
1935 Johnson Miss C. M. Barham, The Training College, Norwich
1926 Jolly Ll. B., Aylmerton Hall, Norfolk
1933 Jolly Miss E., Worstead Lodge, N. Walsham
1885 Jones Sir Lawrence, Bart., 39, Harrington Gardens, London, S.W., 7.
1926 Jourdain Rev. F. C. R., M.A., F.Z.S., M.B.O.U., Whitekirk, Southbourne, Bournemouth

K

1926 Keith E. C., Swanton Morley House, East Dereham
1929 Kerr Mrs. R. S. Rait, 22, Elm Tree Road, St. John's Wood, London, N.W.8
1897 Kerrison Colonel E. R. A., C.M.G., D.L., Birds Place, Buxton, Norwich
1925 Kerrison Mrs., Birds Place, Buxton, Norwich
1938 Kerrison Captain A. G., Hill House, Wroxham
1931 Ketton-Cremer R. W., Felbrigg Hall, Norfolk
1934 Kinder Miss E. E., Manor Farm, Kirby Bedon
1934 King F., Hill House, Northrepps, Norfolk

L

1930 Lance Capt. H. W., Burnham Norton Lodge, King's Lynn
1936 Larking R. C., 5, Mile End Road, Norwich
1936 Larking Mrs. R. C., 5, Mile End Road, Norwich
1931 Lawfield F. W., 219, Hills Road, Cambridge
1932 Leake Mrs., The Gables, South Wootton, King's Lynn
1909 Leicester The Right Hon. the Earl of, G.C.V.O., C.M.G., *V.P.*, Holkham
1899 Leney F., O.B.E., The Lawns, Thorpe Road, Norwich
1938 Lewin M., The Grove, Hainford, Norwich
1936 Liddell Rev. D., 4, Matlock Road, Norwich
1927 Lister Dr. S. R., Little Firs, Salcombe, S. Devon.

Elected

1923 Livesay Surg.-Capt. A. W. B., R.N., 497, Unthank Road, Norwich
1922 Livesay Mrs., 497, Unthank Road, Norwich
1922 Lloyd Capt. L., Taverham Mill, Norwich
1925 Lloyd Mrs., Taverham Mill, Norwich
1899 Long S. H., M.D., F.Z.S., M.B.O.U., *Hon. Mem., V.P.*, 31, Surrey Street, Norwich
1907 Long Mrs. S. H., 31, Surrey Street, Norwich
1919 *Long Miss E. M., 31, Surrey Street, Norwich
1923 Long G. S. B., St. Giles Plain, Norwich
1933 *Low G. Carmichael, M.D., F.Z.S., M.B.O.U., 86, Brook Street, London, W.1
1921 Lucas Baroness, Woodyates Manor, Salisbury

M

1924 MacKenzie Miss G., The Cottage, Ingworth, Norwich
1923 *Macpherson A. Holte, 21, Campden Hill Square, Kensington, W.8
1934 Mahood A. E., F.R.C.S., "Sunnyhaven," Hainford, Norwich
1931 Maidment Dr. F. N. H., Harleston, Norfolk
1937 Maingay Mrs. M., West End Lodge, Aylsham
1905 Mann Sir Edward, Bart., Thelveton Hall, Norfolk
1936 Manning S. A., 4, Patteson Road, Norwich
1931 Maples Ashley K., Havenby, Burnham Overy Staithe, King's Lynn
1931 Marshall E. H., Oriental Club, London, W.1
1931 Marshall W. K., Radburne Estate Office, near Derby
1938 Marsham Rev. A. F., Hevingham Rectory, Norfolk
1912 Mason A., Willow Lane, Norwich
1911 Master George, M.D., West Mill, Bury St. Edmunds
1893 Mayfield A., F.L.S., Mendlesham, Stowmarket
1926 McCall C. Home, C.B.E., Sanctuary, Northiam, Sussex
1933 McHardy Maj.-Gen. A. A., C.B., C.M.G., D.S.O., Hickling, Norfolk
1926 McLean Colin, Humbletoft, East Dereham
1926 Meade Miss P., Quidenham, Norwich
1923 Minns Mrs. E., Hammond's Wood, Frensham, Surrey
1932 Moore R. F., "Runnymede," Runnacleave Crescent, Ilfracombe
1923 Moppe Lewis E. van, Cliffside, Overstrand
1929 Morley C., Monk's Soham House, near Framlingham, Suffolk
1922 Mountfield Miss M., Horsford, Norwich
1921 *Murton Mrs., Cranbrook Lodge, Cranbrook, Kent

N

1925 Neville Sir R. J. N., Sloley Hall, Norfolk
1931 Nevill Capt. G. A., The White Lodge, Swanton Morley, East Dereham
1911 Newman L. F., St. Catharine's College, Cambridge
1915 Nightingale S. R., Scratby Hall, Great Yarmouth
1926 Norfolk and Norwich Library, Norwich
1932 Norgate Mrs., Cranworth, Shipdham, Norfolk
1919 Norgate Philip, Swanington, Norfolk
1933 North The Hon. Mrs. J., Stiffkey, Norfolk
1915 Norwich Public Library

Elected

O

1935 O'Brien Mrs., Swafield Hall, Norfolk
1927 O'Donnell .O, Great Fransham, East Dereham
1914 Oliver F. W., D.Sc., F.R.S., *Hon. Mem.*, *V.P.*, Ballard's Barn Limpsfield Common, Surrey

P

1919 Pain Percy, Dersingham, King's Lynn
1913 Paine Rev. Canon N. W., Great Melton Rectory, Norfolk
1919 *Palmer Mrs. P. Hurry, "Red Roofs," North Drive, Great Yarmouth
1938 Parker D. G. P., 11, Queen Street, Norwich
1912 Parker H., Lyncroft Road, Pakefield, Lowestoft
1873 Partridge Rev. W. H., M.A., Cherry Wood, Straight Road, Lexden, Colchester.
1920 Patteson Mrs. F. E., Great Hautbois House, Norfolk
1932 Patteson Miss, Great Hautbois House, Norfolk
1911 *Payler Donald, The Museum, Birmingham
1923 Peed John, Aylsham
1926 Percy Lord William, D.S.O., Catfield Hall, Norwich
1926 Phillippo G., 48, South Park, Lincoln
1936 Phillips A. S., 56, Acacia Road, St. John's Wood, London, N.W.8
1930 Podmore R. E., Maynards, Matfield, Kent
1931 Pratt Alfred, The Cottage, Cliff Avenue, Cromer
1919 Preston Sir E., Bart., Beeston Hall, Norwich
1900 Preston Dr. F., Cathedral Close, Norwich
1933 Prior A. V., Green End Dell, Boxmoor House, Herts.
1913 Purdy T. W., Woodgate, Aylsham
1887 Pycraft W. P., F.L.S., F.Z.S., Little Paddock, Longcross, Nr. Chertsey, Surrey

R

1929 Ramage H. P., Ridgemont, Carrow Hill, Norwich
1933 Rate L. R., Milton Court, Dorking, Surrey
1928 Raywood W., 13, Upper King Street, Norwich
1934 Reynold Miss J., Clipstone House, Church Road, Watford
1924 Richmond H. W., F.R.S., King's College, Cambridge
1925 Ringrose B., Farley, Harbridge Green, Ringwood, Hants.
1924 Rippingall Neale F., Langham, Norfolk
1911 Rising A. P., The Manor House, Ormesby St. Margaret Great Yarmouth
1908 Riviere B. B., F.R.C.S., F.Z.S., M.B.O.U., *Hon. Member*, Woodbastwick Old Hall, Norwich
1908 Rogers Commander F. S., R.N., Ingham New Hall, Norwich
1909 Rogers Rev. Henry, Coltishall Hall, Norwich
1908 *Rothermere Rt. Hon. Viscount, Stody Lodge, Melton Constable Norfolk.
1936 Rowley A. H. A , 9, Claremont Road, Norwich
1936 Rowley Mrs., 9, Claremont Road, Norwich
1936 Rudd A. J., 22, Clarendon Road, Norwich
1902 *Ruggles-Brice Mrs. R., M.B.E., Northrepps Cottage, Norwich
1906 Rumbelow P. E., 27, Rodney Road, Great Yarmouth

Elected

S

1935 Sales Mrs., Twyford Hall Norfolk
1931 *Salisbury Prof. E. J., D.Sc., F.L.S., F.R.S., Willow Pool, Radlett, Herts
1935 Sanders C. H., Cuckolds, Wrentham, Suffolk
1936 Sargent C. G., Morningthorpe Manor, Long Stratton
1937 Sawbridge Rear Admiral, Thrigby Hall, Norfolk
1937 Scott J. G., East Carleton, Norwich
1937 Scott Mrs. J. G., East Carleton, Norwich
1936 Searle G. O., Flitcham Abbey, King's Lynn
1922 Shepheard Dr. Samuel Aylsham
1938 Silcock Miss Margaret, "Broomhill," Hoveton St. John, Norwich.
1938 Silcock Miss Maud, "Broomhill," Hoveton St. John.
1930 Simpson Miss W., Geldeston Lodge, Geldeston, Norfolk
1937 Skinner J. H. McInnes, Bramerton Grange, Norwich
1915 Smith Mrs. C., Ellingham Hall, Bungay
1919 Smith Col. H. F., Didlington Hall, Norfolk
1926 Smith Mrs. J. E., M.Sc., "Constantia," 68, Elm Grove Lane, Norwich
1917 Sowels Miss. The Rookery, Thetford
1938 Spalding Miss E. R. Tyndrum, Churt, Farnham, Surrey.
1936 Sparrow W., White Hart St., Thetford
1911 Spurrell J. T., Manor House, Newton St. Faiths, Norwich
1923 Spurrell Miss M., Manor House, Newton St. Faith's, Norwich
1923 Spurrell Miss P., Manor House, Newton St. Faith's, Norwich
1935 Squirrell Mgr. Canon H. S., St. John's Catholic Rectory, Norwich
1925 Steers J. A., M.A., St. Catharine's College, Cambridge
1921 Stimpson Edward, Sall Moor Hall, Reepham, Norfolk
1922 Sumpter Dr. B. G., Brancaster Staithe, King's Lynn
1896 Sutton W. Lincolne, F.I.C., Framingham Pigot, Norwich
1938 Swan E. L. Russets, Wooton Road, King's Lynn.

T

1931 Talbot Sir Gerald, K.C.V.O., C.M.G., O.B.E., Burnley Hall, Somerton, Norfolk
1931 Tate Mrs., Lenwade House, Near Norwich
1921 Taylor Dr. Mark R., 4, Wicks Lane, Formby, Lancs.
1933 Taylor Commander M., R.N., United Service Club, Pall Mall, S.W.1
1935 Taylor G. B., 64, St. Leonard's Road, Norwich
1938 Taylor Mrs. E. S. Culpho End, near Ipswich.
1938 Taylor A. S. Culpho End.
1921 Thain D., West Somerton, Norfolk
1935 Thomas J. M. Ridley, F.R.C.S.E., 3, Christchurch Road, Norwich
1896 Tillett Wilfrid S., "Sunnymead," Buxton, Norwich
1933 Tindall Miss E., Woodlands, Thorpe, Norwich
1920 Todd Lt.-Col. Eardley, Mundham House, Loddon, Norfolk
1932 Todd Mrs., Mundham House, Loddon, Norfolk
1902 Todd R. A., B.Sc., The Retreat, Elburton, Plymouth
1936 Trench R. H., Hall Barn Cottage, Windsor End, Beaconsfield
1925 Tucker B. W., 9, Marston Ferry Road, Oxford
1906 Turner Miss E. L., F.L.S., H.M B.O.U., *Hon. Mem.*, 13, Storey's Way, Cambridge

Elected

U

1923 Upcher Rev. E. C. S., Weybourne Rectory, Norfolk
1921 Upcher H. E. S., The Gables, Upper Sheringham
1930 Upcher Mrs. H. E. S., The Gables, Upper Sheringham

V

1917 Vincent James, Hickling, Norfolk

W

1936 Wade Miss O. M., Elmsley, Yoxford, Suffolk
1923 Walter Mrs. Cyril, Tacolneston Hall, Norwich
1923 Waterfield Mrs., Grout's Lane, Salthouse, Norfolk
1936 Watson W. H., c/o National Bank of India, 26, Bishopsgate, London, E.C.2
1936 Watts Miss G., Kibworth Lodge, Sheringham
1937 Watts W. Webster, Eaton Cottage, Norwich
1931 Wheeler G., Tatterford Rectory, Fakenham, Norfolk
1932 Wheeler Engineer-Capt. S. G., R.N., Lower Hellesdon, Norwich
1936 Whitaker S., Ivydene, The Hollow, Littleover, Derbyshire
1937 Whitehead Dr. F. E., C.B.E., 112, Victoria Road, Oulton Broad
1937 White K. G., High School for Boys, St. Giles' Gates, Norwich
1937 Whytehead Miss E. K., Eaton Vicarage, Norwich
1922 Willett W. L., The Rosery, Matfield, Kent
1937 Williams Miss A., Trinity Street, Norwich
1929 Wilson Mrs. Gerald, Saxlingham Nethergate, Norwich
1909 Witherby H. F., M.B.E., F.Z.S., 326, High Holborn, W.C.
1934 Wontner Rev. T. S., Ashby St. Mary Rectory, Norwich
1923 Woolsey G. E. W., Old Catton, Norwich
1907 Wormald Hugh, M.B.O.U., Heathfield, East Dereham
1922 Wortley Francis, Half-Year, West Runton, Norfolk
1938 White Rev. W. W., Gunton-with-Hanworth Rectory, Norfolk.

Y

1915 Yarmouth Free Library, The, Great Yarmouth

Honorary Members	4	370
Life Members	23	
Ordinary Members	343	

DISTRIBUTION OF MEMBERS.

Norwich	89	370
Other Norfolk	197	
Outside Norfolk	84	

NORFOLK & NORWICH NATURALISTS' SOCIETY, 1937-8.

GENERAL ACCOUNT.

Dr.	£ s. d.	£ s. d.	Cr.	£ s. d.	£ s. d.
1937-38.					
To Balance		14 0	By Transactions Printing	121 1 9	
„ Subscriptions		175 6 0	Postage, etc.	4 4 2	
„ Interest on Investments, £300 4% Consols	9 0 6			125 11 11	
£105 6s. 10d. War Loan	3 13 8		Less Sales	15 2	
		12 13 8	„ Publication Fund—		
„ Sales Scolt Head Handbook		5 12 6	W.B.P.A.	£10 0 0	
„ E. A. Flora		13 8	Smaller Sums	2 8 6	
				13 3 8	
					112 8
			„ Expenses of Meetings		8 14 0
			„ Library Rent		6 6 0
			„ Subscriptions to other Societies, etc.		0 16 0
			„ Printing and Stationery		4 2 0
			„ Assistant Secretary Honorarium		15 0 0
			„ Balance at Barclays Bank		42 15 10
		£195 1 8			£195 1 8

LIFE MEMBERSHIP ACCOUNT.

	£ s. d.		£ s. d.
To Balance	35 1 9	By Balance at Savings Bank	37 14 2
„ Interest on £50 War Loan	1 15 0		
„ Bank Interest	17 5		
	£37 14 2		£37 14 2

LIBRARY ACCOUNT.

	£ s. d.		£ s. d.
To Balance	66 16 6	By Purchase	11 12 4
„ Interest	1 4 4	„ Balance at Savings Bank	56 8 6
	£68 0 10		£68 0 10

I have audited the above Accounts and found correct.

12th April, 1936

C. R. A. HAMMOND.

I

THE SEASON, 1937–38.

Remarks by the President

During the year April, 1937–38, twenty-four new members have been elected ; but we have greatly to regret the loss by death, among others, of the Duchess of Bedford and Sir Maurice Boileau. We have also sustained a loss by the departure from the County of one of our best field Ornithologists, Mr. R. M. Garnett, whose records in the Transactions will be very much missed. Our membership now stands at 370. We welcome Miss Meade as Hon. Secretary of the Junior Branch of this Society, an office which I may say after eight years' experience is no sinecure, but is important as the nursery of the Senior Society.

During the year we have had many interesting meetings and excursions, thanks to our Hon. Excursion Secretary, Mr. H. W. Back, who in addition to his work as Hon. Secretary has found time to organize these outings so successfully. I will only mention two of these which seem to me a useful departure from the ordinary. On May 8th by kind invitation of Mr. and Mrs. H. W. Back we visited Hethersett Hall, and during the afternoon Members scattered about the grounds and made notes and collected specimens, and after tea those Members previously asked to do so named the specimens and answered questions about them. I gathered afterwards that this form of excursion was greatly appreciated, as it helped members to acquire knowledge in the branch of Natural History in which each was most interested. The other excursion was to Staverton forest in Suffolk, when Mr. Notcutt kindly acted as our guide. We have in the past from time to time visited neighbouring counties, and this made a pleasant change from our usual excursions.

The good attendance at our excursions and meetings seems to justify the conclusion that our Society is successfully interesting its members in the various branches of natural history. Nevertheless, as it is said that criticism is good for the individual,

I suppose to some extent this also applies to a Society. Therefore, I will quote a criticism of Norfolk Naturalists from the review of our Transactions of 1936 by the Editor of "British Birds," published in that magazine for August, 1937 :— "There is a decided lack of notes especially on locally distributed birds from outside the specially protected areas" such as Scolt Head, Hickling, etc. I feel that a statement made by such an eminent ornithologist as Mr. H. F. Witherby, who is a past president of this Society, is worthy of our serious consideration.

In his presidential address to us in 1929, Mr. Witherby gave a most comprehensive and helpful "Guide to some Ornithological work" in which he stressed the importance of "co-operative observation," which he said "can achieve results not obtainable in any other way," and that "it has such great possibilities that means to exploit it should be very carefully considered by every Naturalist Society." Hampshire, Kent, Surrey, and Sussex, have published a joint report under the title of "South-eastern Bird Report" in which about 100 contributors from all parts of these counties send in records to this Report, and the Oxford Ornithological Society has joined with Oxfordshire, Berkshire, and Buckinghamshire in publishing their record of birds. Would it not be possible for us to organize in some such way as this, a Norfolk or East Anglian Report, to which observers would regularly contribute from all parts of this County? To the bird notes might be added notes on other branches of Natural History. Something has been done in this direction chiefly owing to the enthusiasm of Mr. Edward Ellis, who for some time has organized weekly nature records in the *Eastern Evening News*. Perhaps these observers might form a nucleus for a Norfolk Report.

REPORT BY THE SECRETARY.

The following meetings took place :—

1937, 19th October. Specimens were exhibited, including recent additions to the natural history collections in the Castle Museum.

1937, 16th November. Mr. William Buston gave an address on Trees, illustrated by lantern slides, many Norfolk examples being shown.

1937, 7th December. Mr. H. J. Howard, F.L.S., described with lantern slides his recent journey through Finland to the Arctic coast.

1938, 18th January. Major Anthony Buxton showed films of red deer, black-cock, lesser spotted woodpecker, purple gallinule, and honey buzzard.

1938, 15th February. Mr. G. O. Searle, B.Sc., P.A.S.L., of the Norfolk Flax Research Institute told the story of " Flax, from seed to linen," with lantern slides and specimens.

1938, 15th March. Mr. P. E. Rumbelow described some of his " Rambles in Norfolk and Suffolk," making some reference to coast changes and the recent flooding at Horsey.

1938, 19th April. The 69th Annual Meeting was held in Norwich Castle Museum. Mr. E. T. Boardman was elected President and Mr. Hugh Wormald President-elect. Miss J. M. Ferrier, the retiring President delivered her Presidential Address.

Excursions.

During 1938, four excursions were held :—

26th May. To Longmoor Point, Sutton Broad, at the invitation of Miss Catherine Gurney. Royal ferns, *Osmunda regalis* were seen in one of the fen carrs ; swallowtail butterflies visiting rhododendron blooms ; numerous caterpillars of *Tortrix viburniana* Fabr. feeding on bog myrtle ; a colony of red willow beetles, *Melasoma populi* L. ; one of the less common ladybirds, *Calvia* 14-*guttata* L. ; the sawflies *Athalia lineolata* Lep. and *Selandria serva* F. on flowers of celery-leaved buttercup ; great numbers of small blue-bodied dragonflies, *Cænagrion puella* L. and *C. pulchellum* Van der Lind. ; a fine darter dragonfly *Libellula fulva* Müll. ; the daddy-long-legs *Tipula variicornis* Schum. and *Ptychoptera contaminata* L. ; fungi including *Trametes rubescens* (A. & S.) Fr. on old sallow branches, *Naucoria submelinoides* Kuhner, variety *alnetorum* R. Maire and *N. escharoides* Fr. in carrs ; Mrs. G. J. Cooke discovered two specimens of the rare *Verpa digitaliformis* Pers. under sallows and alders near the broad.

9th June. To How Hill, Ludham, at the invitation of the President and Mrs. Boardman. Members much enjoyed seeing the water-garden and exploring fens and alder carrs surrounding Crome's Broad. A bittern was put up from reeds

near the river. Mr. Jim Vincent caught a damsel-fly, *Agrion splendens* Harris, an uncommon insect in that neighbourhood. A large sawfly, *Cimbex femorata* L. was found newly emerged under a birch. Butterflies included swallowtails, seven red admirals and a painted lady; caterpillars of the emperor moth were numerous on a blackthorn hedge. Several mycetozoa and fungi were collected round the broad; as at Sutton Broad, *Naucoria escharoides* and *N. submelinoides alnetorum* grew in carrs, while *Polyporus varius*, *Trametes rubescens* and *Solenia anomala* were present on dead willows.

9th July. To Buxton Heath (Hevingham) and Booton Common. This proved a good botanical excursion. In the damper parts of the heath all three kinds of sundew, early flowers of autumn gentian, small butterfly orchis, marsh helleborine, *Juncus squarrosus* and quantities of flea sedge were noted. A dozen specimens of the very rare bog puffball (*Bovistella paludosa*) were found in a group, also a large *Omphalia sphagnicola* Berk. Yellow clustercups of a rust, *Puccinia dioicæ* P. Magn., were plentiful on marsh thistle in both localities visited and at Booton the uredo—and teleuto—spores were found on *Carex dioica*. Orchids were fine and numerous on Booton common, including the scented *Habenaria conopsea*; the small water plantain, *Echinodorus ranunculoides* was seen in a shallow ditch and only one species of sundew (*Drosera longifolia*) seemed to be present. *Lactarius tabidus* Fr., growing under sallows, was one of the few agarics seen.

24th September. A fungus foray took place in the Great Wood, Felbrigg, at the invitation of Mr. Ketton-Cremer. Mr. G. J. Cooke led the party and 108 species of the larger fungi were recognised; the most noteworthy find among the agarics in the mixed woodland was *Lepiota felina* (Pers.) Fr.

II

THE JUNIOR BRANCH OF THE NORFOLK AND NORWICH NATURALISTS' SOCIETY.

Annual Report, 1938

The Junior Branch is primarily intended for those young people who being at School or College are unable to attend the Meetings of the Senior Society, but others interested are eligible.

The Annual Subscription is 2s. 6d.

The present membership numbers 94.

Four Meetings were held in 1938, viz :—

January 18th.—By invitation of Major Buxton the members went to see his film of red deer and various birds shown to the Senior Society, after meeting for tea at the Y.W.C.A.

April 21st.—An all day meeting was held at Felthorpe Hall, by kind invitation of Sir Basil and Lady Mayhew. A large number of members gained much knowledge and enjoyment from the games and competitions arranged.

April 23rd.—A days excursion was held to Scolt Head Island where members were instructed in the many plants birds and other creatures, which they found there, and had tea at Sheld-Duck Hut.

September 1st. Many members enjoyed a day at Old Buckenham Hall by kind invitation of Mr. and Mrs. T. J. Elliott Sewell, where special study was given to the large number of interesting trees.

BALANCE SHEET for Year ending, 30th September, 1938.

Receipts.	£	s.	d.	Payments.	£	s.	d.
Balance from 1937	4	4	0	Postages		13	8
50 members' subscriptions ...	6	2	6	Printing Notices		8	0
Non-members tea and boat ...	2	2	6	Account and Receipt Books		1	8
				Tea for 4 meetings	2	11	1
				Boat Excursion to Scolt ...		10	0
				Balance in hand	8	4	7
	£12	9	0		£12	9	0

Patricia H. J. Meade,
(Hon. Secretary).

III.

PRESIDENT'S ADDRESS

THE CAMARGUE RESERVE IN SOUTHERN FRANCE

Presidential Address, delivered by Judith M. Ferrier, F.Z.S., M.B.O.U. to The Norfolk and Norwich Naturalists' Society, at Castle Museum, Norwich, on April 19, 1938.

THE CAMARGUE RESERVE.

My subject is "The Reserve of the Camargue of France," with special reference to the method of preservation adopted, and a description of the nesting-birds which would be of outstanding interest to British ornithologists. I have chosen this subject because the members of the International Ornithological Congress which is to be held in May in France are to visit the Reserve of the Camargue after the termination of the Congress, and the Secretary, Monsieur Delacour, has sent an invitation to members of this Society to attend the Congress. I have subsequently added a short account of this Congress.

The Ille de la Camargue is the area of land enclosed in the Delta of the Rhône, bounded on the east and west by the Grand and Petit Rhone, and forming a rough triangle with the Mediterranean as its base, and the ancient town of Arles as its apex. Most of this region is a vast plain interspersed with shallow fresh and salt lagoons of varying extent. The waste land around is covered with salt-loving plants and shrubs, such as *Statice Salicornia* and *Sucœda*, similar to those to be seen on Scolt Head Island and Blakeney Point, and as in these places the soil is cracked, giving the effect of a jigsaw puzzle. The little cultivation to be found lies in the country around Arles and along the borders of the Grand and Petit Rhône, where the fresh water has enabled small fringes of trees, oaks, white poplars, elms, tamarisk, and bamboos to grow, while a few fir trees are also found around the isolated farm houses and keepers' cottages.

The animals inhabiting the district include wild boars, foxes, badgers, weasles, beavers, and rabbits, though with the exception of the rabbits they seem to keep much to cover.


BRITISH MUSEUM
NATURAL HISTORY

The Camargue, France, showing Bird Reserve.

I came across one or two vipers on the marshes, and grass snakes are not uncommon, but the greatest inconvenience to the visitor is the mosquitos which are present literally in swarms, and against which some protection should be taken.

THE RESERVE

The fear that the wonderful bird life in the Camargue might be destroyed, caused the Société d'Acclimation de France, to acquire with the co-operation of local authorities rights over some 20,000 acres towards the centre and south of the Ille de la Camargue, as a Nature Reserve. The aim of the Society is to preserve equally the natural fauna and flora of the district. The Reserve includes the large shallow salt lagoon called La Vaccarès situated towards the centre, where flamingos may frequently be seen. There are other smaller shallow salt lakes towards the south-west and large tracts of barren stony land—while in the east near the main road lies the Salin de Badon, where the head keeper's house is situated.

The management of the Reserve is under the direction of Monsieur Tallon, who has an office in Arles. Under Monsieur Tallon are a head keeper and five under-keepers all living in different parts of the Reserve. They are supplied with horses to enable them to traverse the marshes and lagoons. The Society is anxious to assist all students of Natural History, and the keepers are accordingly instructed to show them over the Reserve. It is the duty of the head keeper on his rounds each day to observe and to note any migrants as well as any nesting birds, and to his notes are added those of any well-known naturalists visiting the Reserve. One of his most important duties is the ringing of birds; a thousand to sixteen hundred are ringed each year.

Before permission is granted to stay in the Reserve a visitor has to sign a paper agreeing to observe the Rules of the Society. These are as follows:—

The destruction of any bird or animal is forbidden.

Nothing must be done to disturb animal life.

Egg collecting is forbidden.

No branches of trees may be cut, no flowers picked, and no alien plants or seeds may be introduced.

Though the aim of the Society is to make the Reserve a complete sanctuary for all forms of animal life, it has been

found necessary to keep down the numbers of wild boars, foxes, rabbits, etc. The only bird whose numbers have been restricted is the magpie, for the marsh-harrier is destroyed so effectively outside the limits of the Reserve that the Society considers the harm it does is of very little importance.

In May, the best month in which to observe the nesting-birds, the sun is very hot in the middle of the day and it is much more agreeable to work in the early morning ; therefore for those naturalists who wish to make a serious study of the wild life in the Camargue, and who do not mind the simple life, it will be found more convenient to stay in one of the keepers' cottages on the Reserve. The head keeper's house at the Salin de Badon is comfortable, with four bedrooms and a sitting room for the use of visitors, while the keeper's wife provides simple but appetizing food. On the other hand, if less strenuous work is contemplated, the ancient town of Arles at the most notherly point of the Camargue makes very good headquarters. There is a road which passes the head keeper's house at the Salin de Badon and in this way day excursions to the Reserve can easily be made. If it is decided to stay in Arles and time allows, Les Baux would be worth a visit as the blue rock thrush is to be found nesting there, as well as several other birds not found in the Camargue. At La Crau, a vast stony plain of some eighty miles in extent which stretches nearly to Arles, may be seen the in-tailed sand grouse and other birds. For those interested in archæology and architecture Arles will well repay a visit as it is full of Roman remains.

To reach the head keeper's house a car should be hired, and after leaving Arles the Grand Rhône is crossed and turning south the Ille de la Camargue is entered. The car soon leaves all buildings behind and the road passes over miles of marsh and stony waste ; on either side are dykes, fringed with tamarisk bushes poplars or willows. Now and again a snake will flash across the road in front of the car, and herds of the black fighting bulls may be seen on the marshes. The road passes along the eastern shore of the large salt lagoon known as La Vaccarès, and in another few miles the Salin de Badon is reached. The head keeper's house lies near the road among a group of fir and other trees ; behind it, on some rough stony

ground, sea blite (*Suæda*) and glass wort (*Salicornia*) grow. Not far from the house are several lagoons, some thickly grown with tall reeds; while in another direction stretch marshes divided by dykes bordered with trees or tamarisk bushes.

The Birds that nest in the Reserve.

I will group the most interesting of the various birds nesting in the Camargue Reserve under the different types of country in which their nests are most likely to be found.

(1) Birds found nesting in trees bushes and undergrowth.
(2) Ground nesting birds.
(3) Birds nesting among reeds.
(4) Birds nesting under the eaves of houses, in holes, in cliffs, etc.

(1) Birds found nesting in Trees Bushes and Undergrowth

Many of the birds in this first section can be seen within walking distance of the keeper's house at the Salin de Badon.

The Magpie is one of the commonest birds throughout the Camargue, perhaps on account of its adaptable habits, for while it frequently nests in tall trees, here where they are scarce it places its nest in bushes a few feet from the ground.

The Carrion Crow is the only other member of the Crow family recorded nesting in the Reserve, and I understand that it is far from common.

The Golden Oriole also nests sparingly. The gold and black plumage of the cock-bird and its sweet whistle—though perhaps a little monotonous—make this bird very attractive. It makes a beautiful nest, which it slings like a hammock between the forked twigs of a tree, frequently at a considerable height from the ground.

The Roller is another brightly-coloured bird, the azure blue and chestnut brown of its plumage, and its habit of flying up and turning somersaults attract attention. Its rolling somersaults gave the bird its name. It nests in holes, and possibly owing to lack of suitable nesting sites is not very common.

The Hoopoe is not as brightly coloured as the last two birds, being a soft cinnamon pink with bars of black and white on its back and wings, but it has a very arresting black and white

tipped crest, which it raises and depresses especially when it is calling its long drawn hoo-hoo-hoo. I heard it calling constantly when staying at the Salin de Badon, and found a nest with young not far from there. These brightly coloured birds with their quaint ways are especially attractive to those who are most familiar with the more soberly-coloured birds of the British Isles.

Among the shrikes, the Woodchat Shrike is the most commonly seen in the Reserve, and at the same time is perhaps the most attractive with its chestnut red crown and nape surrounded by black, and its general black and white appearance, while the Lesser Grey Shrike and the Southern European Grey Shrike also breed in small numbers. All these are rare visitors to the British Isles.

The Penduline Tit—which has never been recorded in the British Isles—is one of the most attractive and unique birds to be seen in the Camargue. In colour it reminds me a little of the bearded tit, as it has black on its head with a white throat, and its crown shading into grey on the nape of its neck. Its back is bright chestnut, but it lacks the long tail and black moustache of the bearded tit. The nest of the penduline tit is probably the most elaborate nest of any European bird. It has been described as pear-shaped, or the shape of a bagpipe, with the pipe cut off short; the entrance at the top of one side resembles the spout of a teapot. It is usually about six to seven inches deep and about three and a half across (exterior measurement), made of several kinds of vegetable down taken from willow or poplar catkins mixed with wool. The whole is beautifully "felted" together, and with the aid of fibres and the roots of grasses it is suspended from the upper branches of an elm willow or tamarisk, often on those growing at the side of a dyke or on the edge of the Rhône. Sometimes suspended several feet above the water it swings on a twisted rope made of roots and grasses attached to the fine twigs at the end of a branch. The nest takes many weeks to build, although both birds share in its construction. The eggs usually five to seven in number are white and elongated. In their habits these birds are very tit-like, clinging upside down to the branches of the trees and uttering a characteristic

long-drawn 'Scheeeou.' They are not shy, and will continue building or feeding their young without fear of a visitor who sits quietly a few yards from the nest.

Of the warblers that nest in bushes, the CITTIS and the MELODIOUS and SPECTACLED WARBLERS are of special interest as they are very rare, if not absent from the British list.

Among the owls, SCOPS OWL (the French call it "Petit Duc") has a very distinctive monotonous call.

The LITTLE EGRET is a very attractive small white heron with fine crest and soft plume-like feathers on its back and breast. These feathers are known in commerce as "Osprey" and are much sought after in unprotected areas.

These birds nest in the company of NIGHT HERONS and SQUACCO HERONS in trees or bushes on the banks of the Rhone. In 1934 the colony of these three birds numbered some 2,000 nests. It is believed to be the only colony in France.

2. GROUND NESTING BIRDS

THE FANTAIL WARBLER. This tiny warbler is to be found among long grass scrub or clumps of sedge. It has a jerky flight and a way of rising into the air and fanning its conspicuous black and white tipped tail. Its call note is a shrill 'cheep–cheep' two distinct notes somewhat resembling the chiff chaff but with a slighter interval between the notes. Its nest is a flimsy structure suspended in the long grass and most difficult to find. Mr. B. Guy Harrison tells me he found seven nests in that district in 1936.

Several kinds of lark are found nesting. The SKYLARK, CRESTED LARK, SHORT-TOED LARK and the CALANDRA LARK. The last is decidedly local. This bird is most frequently met with on the stony plain known as "La Crau."

The TAWNY PIPIT is the only pipit nesting in the Reserve and is rare. I only saw a few during my stay.

THE PRATINCOLE, a very rare vagrant to the British Isles, has pointed wings and tail giving it some resemblance to a large swallow. It makes little or no nest, on the ground. I understand that although its nest has been recorded, it is far from common.

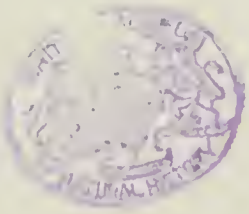
THE KENTISH PLOVER AND AVOCET are both comparatively plentiful. The AVOCET, is fascinating to watch as it wades

through the pools drawing its bill from side to side with a sweeping flail-like motion through the shallow water in search of minute insects. As many as five hundred nests have been found on the islands in the lagoons, and Mr. Harrison tells me he found a nest with six and one with eight eggs in 1936 obviously the result of dual laying, ; a keeper told him that he had found nests containing eight and twelve eggs in the same year. The usual clutch is four.

The Black-winged Stilt is a rare visitor to the British Isles. It was seen at Hickling in May, 1929 by Mr. Jim Vincent. In size it is a little larger than a redshank, in colour black and white with a lovely green sheen on its wings. It has long pink legs, straight black bill, and eyes of a vivid carmine. It nests on swampy marshland where there are pools of shallow water surrounded by reeds.

There were several nests on a marsh near the Salin de Badon and it was here that I photographed it in 1930. It also nests on the islands in the lagoons. The nest I found was made of the stalks of grasses mixed with mud and was placed on a tuft of coarse grass a little above some shallow water. The eggs were pale buff in ground colour with spots and blotches of dark brown.

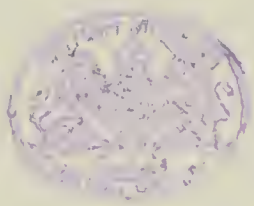
The hide had been put up some time beforehand so that the birds had grown accustomed to it, and they returned some twenty minutes after I had entered and flew round and round calling loudly, their necks outstretched and their long legs trailing. Then the hen bird approached the nest, walking daintily through the water, pausing every now and then to listen or to pick up some insect from the surface of the water. She disappeared among the grasses and came out again near the nest bending over it as if to make sure that the eggs were still there. Then she gently lowered herself on to the nest, puffing out her feathers so as to cover all the eggs and doubling up her long legs on each side of her body. At first she sat alert with her head up, one bright red eye on the camera, while her mate lurked a little way off, and every now and again they would call to each other, but after a short time he went away and she settled down happily. I watched the black-winged stilts from my hide on three separate occasions, but never saw the



Black-winged Stilt about to settle on nest

Black-winged Stilt on nest

Nest and eggs of Black-winged Stilt



birds change places at the nest. When arriving the bird alighted among the grass and then walked on to the nest, but when leaving it flew directly off the nest.

The Flamingo is described in the Society's Report as the ornithological pearl of the Camargue, which is believed to be its only breeding ground in France. It is seen in varying numbers during most months of the year, though the majority leave to winter further South. The number of nesting birds varies considerably from year to year. Their food in the Camargue is said to consist chiefly of the small crustaceans—brine-shrimp (*Artemia salina*), which abound in these saline lagoons.

To see these birds except in very dry weather a somewhat arduous trek must be made across mudflats into one of the more secluded shallow lagoons, where through the haze which frequently hangs over them a blur of soft pinkish white appears in the distance. On a nearer approach this proves to be a flock of some hundreds of flamingoes, moving slowly along frequently pausing, their heads submerged, evidently feeding on something in the shallow water. From time to time a bird will raise its head and utter its low call, when the heavy pink black-tipped bill will come into view. Again, if suddenly disturbed by the too near approach of intruders, the whole flock will raise their necks and with heads to wind slowly unfold their wings: the soft pinkish white of the mantle which hid their splendour then gives way to the vivid rosy scarlet of the outstretched wings. They rise into the air one after another in line formation with outstretched swan-like necks and long trailing pink legs, honking much after the manner of geese. The flamingo makes its nest of mud collected into a heap, not unlike a mud pie. It nests in colonies on one or more of the many islands found in the larger salt lagoons, especially La Vaccarès, and those bordering the Mediterranean, Etang dit L'Impérial, Fangassier, etc. M. Tallon mentions that 1,800 nests have been recorded. The eggs are white and usually two in number.

Several species of duck breed in the Camargue. They make their nests on the islands in the lagoons, placing them among the thick masses of seablite or other scrub.

The Red Crested Pochard is a very handsome bird, larger than the common pochard, with carmine red bill, golden-bay crest, and white patches on the shoulders. It is a very rare vagrant to the British Isles, but is common in the Camargue, especially on the islands in the Etang dit 'l'Impérial. The depth of the water in the different lagoons varies from year to year and is sometimes too deep to wade, when a light boat would be a great help.

There are several kinds of tern. The Common Tern and the Little Tern nest in the lagoons that border the Mediterranean. The Gull-billed Tern nests in quite large colonies on the islands of the Etang dit l'Impérial ; while the Black Tern White-winged Black Tern and Whiskered Tern have bred in the vicinity of the Salin de Badon. They nest rather late and were only starting to breed when I was there during the third week in May.

3—Birds nesting among Reeds

Two kinds of warbler build their nests among the dense reed beds that border the fresh water lagoons. The Great Reed Warbler makes its presence known by its loud harsh song, and is more numerous than the Common Reed Warbler.

The Bearded Tit also nests in small numbers.

The Water Rail is fairly common especially in the district around the Salin de Badon, while Baillon's Crake is also recorded as nesting.

The Purple Heron is common. I saw three different colonies in the thick reeds in a lagoon quite near the Salin de Badon ; there were 33 nests in all in 1930.

In the same lagoon I found a Bittern's nest with young.

Several Marsh Harriers breed in the Reserve, and I knew of two nests in 1930, one of which was not far from the purple heron colony among the tall reeds. The water in that summer in this lagoon was not very deep, but it varies in different years, and it is advisable to have water-boots or better still long waders for leeches are sometimes troublesome.

4.—Birds Nesting under the Eaves of Houses, and in holes in Cliffs, etc.

The Swallow is common, and the House Martin also nests, but it is not so numerous.

The Bee-Eater is seen in small parties during migration. Its gorgeous colours, orange-yellow kingfisher blue and chestnut, flash as it darts about in swallow-like flight. Only occasionally a few remain to nest in holes in cliffs or river-banks.

Migration

The Rhône valley is a favourite route for birds of passage as well as for migrants during the spring and autumn, while duck in large numbers are seen on the lagoons during the winter.

Besides the 95 species of nesting birds shown in the attached list, I understand that the Egyptian Vulture is seen regularly in small numbers, and that it nests in the mountains north-east of Arles. Bonelli's Eagle is also fairly common, and I saw several in 1930. The Short-toed Eagle has not been so common in recent years, but is still sometimes seen; the French call it "Jean Le Blanc." On the edge of the lagoons that border the Mediterranean many different kinds of waders, Golden and Grey Plover, Dunlin, Ruff, Spotted Redshank and others—rest on their journey to or from their nesting grounds.

The Camargue is an exceptionally interesting place in which to study bird-life, and every help is given to those who wish to do so by Monsieur G. Tallon, Secretary of the Reserve. For information and notes given me on the birds of the Camargue my grateful thanks are due to Monsieur G. Tallon, Mr. B. Guy Harrison, F.Z.S., M.B.O.U. and Mr. W.E. Clegg, M.B.O.U., who lent me some of his very fine slides which I showed among mine at the Annual Meeting of this Society.

THE NINTH INTERNATIONAL ORNITHOLOGICAL CONGRESS.

I attended this Congress which was held at Rouen from May 8th to 15th, 1938 under the presidency of Professor A. Ghigi, Rector of the University of Bologna.

On May 11th the Members were invited to Clères by Madame Delacour and her son Monsieur Jean Delacour, Secretary of the Congress and a well-known collector for the Zoos of London, Paris, and New York. This provided an opportunity of seeing many rare water-fowl in a beautiful setting of the lake and park, where they are given a large amount of freedom.

At Clères flamingoes are to be seen walking about the lawns or wading in the lake, while brightly coloured macaws and parrakeets fly overhead, and gibbons perform acrobatics in some trees on an island ; there are several kinds of antelope in the park. Excursions were also made to the valley of the Seine, to the forests of Bortonne, Mauny, and Roches d'Orival, and subsequently to the Camargue.

The scientific programme covered all branches of ornithology and was divided into four sections, the lectures being given in different languages.

1st Section : Taxonomy and Zoo-Geography.

2nd Section : Anatomy, Physiology, Palæontology, and Embryology.

3rd Section : Biology (Ethnology, Ecology, Migration, Oology, etc.).

4th Section : Applied Ornithology (Economic Ornithology, Taxidermy, Observations and Experiments on Birds in captivity).

Several excellent films were shown, including Professor A. Allen's sound-film partly in colour of the Ivory-billed Woodpecker and Trumpeter Swan, Dr. M. Stolpe's slow-motion film of the flight of the Humming Bird, Dr. K. Lorenz's demonstration of the psychology of the young of the Grey-lag Goose reared in captivity, and Captain Knight's studies at the nests of the Hammerhead Stork, Secretary Bird, and Crowned Hawk Eagle. Dr. M. Stanislaus showed an X-ray film proving for the first time the antagonistic movement of air sacs.

About 300 Members took part in the Congress and thirty-two nations were represented. The study of ornithology bridged the gulf between different nationalities and members worked in perfect harmony. Dr. Percy Lowe, President of the B.O.U. represented the British Government. It was agreed that the tenth International Congress of Ornithology should be held in America with Dr. Wetmore as President.

LIST OF BIRDS FOUND NESTING IN THE CAMARGUE, FRANCE

Compiled to a large extent from information received from M. Tallon, Director of the Reserve of the Camargue, and from personal observations during visits to the reserve in 1930 and 1938.

Carrion Crow. *Corvus corone corone* L. (not common).

Magpie. *Pica Pica* L. (very common).

Golden Oriole. *Oriolus oriolus oriolus* L. (found nesting in suitable localities in fair numbers).

Greenfinch. *Chloris chloris aurantiventris* Cabanis (common in suitable localities).

Goldfinch. *Carduelis carduelis africana* Hartert (common in suitable localities).

Linnet. *Carduelis cannabina* L. (local but not uncommon).

Serin. *Serinus canaria serinus* L. (rare).

Chaffinch. *Fringilla cælebs* (L. rare).

House Sparrow. *Passer domesticus* L. (common).

Tree Sparrow. *Passer montanus* L. (local but not uncommon).

Corn-Bunting. *Emberiza calandra calandra* L. (common).

Cirl Bunting. *Emberiza cirlus cirlus* L. (rare).

Witherby's Reed Bunting. *Emberiza schœniclus witherbyi* Jordans (common).

Calandra Lark. *Melanocorypha calandra calandra* L. (rare).

Short-toed Lark. *Calandrella cinerea brachydactyla* Leisler (not uncommon).

Crested Lark. *Galerida cristata cristata* L. (not uncommon).

Sky-lark. *Alauda arvensis arvensis* L. (common).

Tawny Pipit. *Anthus campestris campestris* L. (rare).

Ashy-headed Wagtail. *Motacilla flava cinereocapilla* Savi (common).

Tree Creeper. *Certhia brachydactyla brachydactyla* Brehm (rare).

Great Titmouse. *Parus major major* L. (common).

Blue Titmouse. *Parus cæruleus cæruleus* L. (local and scarce as nesting species).

Long-tailed Titmouse. *Aegithalos caudatus caudatus* L. (local, rare nesting species).

Bearded Titmouse. *Panurus biarmicus biarmicus* L. (local, nesting in small numbers.)

Penduline Titmouse. *Anthoscopus pendulinus pendulinus* L. (common in suitable localities).

Lesser Grey Shrike. *Lanius minor* Gm. (local, nesting in small numbers).

Southern European Grey Shrike. *Lanius excubitor meridionalis* Temm (rare).

Woodchat-Shrike. *Lanius senator senator* L. (common in suitable localities).

Red-backed Shrike. *Lanius collurio collurio* L. (rare).

Cetti's Warbler. *Cettia cetti cetti* Temm. (common in suitable localities).

Moustached Warbler. *Lusciniola melanopogon melanopogon* Temm (rare).

Great Reed Warbler. *Acrocephalus arundinaceus arundinaceus* L. (common).

Reed Warbler. *Acrocephalus scirpaceus scirpaceus* Herm. (less common than last).

Melodious Warbler. *Hypolais polyglotti* Vieill (found in suitable localities).

Garden Warbler. *Sylvia borin borin* Bodd. (rare).

Blackcap. *Sylvia atricapilla atricapilla* L. (common in suitable localities).

Whitethroat. *Sylvia communis communis* Lath. (common in suitable localities).

Fantail Warbler. *Cisticola juncidia* (found in suitable localities).

Spectacled Warbler. *Sylvia conspicillata conspicillata* Temm (found in suitable localities).

Mistle-Thrush. *Turdus viscivorus viscivorus* L. (not common).

Blackbird. *Turdus Merula* (not common).

Wheatear. *Œnanthe œnanthe œnanthe* L. (found in suitable localities).

Nightingale. *Luscicola megarhyncha megarhyncha* Brehm (common in suitable localities).

Whinchat. *Saxicola rubetra rubetra* L. (rare).

Stone Chat . *Saxicola torquata rubicola* L. (found in suitable localities).

Swallow. *Hirundo rustica* L. (not uncommon in suitable localities).

House Martin. *Delichon urbica* L. (found in suitable localities).

Swift. *Apus apus apus* L. (local as nesting species).

Hoopœ. *Upupa epops epops* L. (common in suitable localities).

Roller. *Coracias garrulus garrulus* L. (Found in small numbers in suitable localities. Said to be the only nesting place in France).

Kingfisher. *Alcedo atthis ispida* L. (rare).

Green Woodpecker. *Picus viridis viridis* L. (local but not rare).

Cuckoo. *Cuculus canorus canorus* L. (rare).

Little Owl. *Athene noctua vidalii* A. Brehm (common.)

Scops Owl. *Otus scops scops* L. (common).

Barn Owl. *Tyto alba alba* Scops (found in small numbers—very local).

Kestrel. *Falco tinnunculus tinnunculus* L. (common in suitable localities).

Marsh Harrier. *Circus æruginosus æruginosus* L. (found in suitable localities).

Purple Heron. *Ardea purpurea purpurea* L. (common).

Little Egret. *Egretta garzetta garzetta* L. (Camargue said to be the only nesting place in France).

Squacco Heron. *Ardeola ralloides ralloides* Scop. (a few are found nesting with the egret).

Night Heron. *Nycticorax nycticorax nycticorax* L. (Found nesting with last two. In 1934 there were some 2,000 nests of Egret and Night Heron all together).

Little Bittern. *Ixobrychus minutus minutus* L. (rare).

Bittern. *Botaurus stellaris stellaris* L. (not uncommon).

Flamingo. *Phœnicopterus ruber antiquorum* Temm. (Several thousands seen in the Camargue during each year, but number of nesting birds not known).

Mallard. *Anas platyrhyncha platyrhyncha* L. (common).

Garganey. *Anas querquedula* L. (most common on passage).

Gadwall. *Anas strepera* L., (recorded as nesting).

Pintail. *Anas acuta acuta* L. (most common in winter—also recorded as nesting).

Marbled Duck. *Anas angustirostris* Men. (rare—nest recorded).

Shoveller. *Anas clypeata* L. (not uncommon—some nests recorded).

Red-crested Pochard. *Netta rufina* Pall. (common).

Great Crested Grebe. *Podiceps cristatus cristatus* L. (fairly common).

Little Grebe. *Podiceps ruficollis ruficollis* Pall. (fairly common).

Turtle-Dove. *Streptopelia turtur turtur* L. (common).

Stone Curlew. *Burhinus œdicnemus œdicnemus* L. (thinly distributed in suitable localities).

Pratincole. *Glareola pratincola* L. (rare—nest recorded).

Oyster-Catcher. *Hæmatopus ostralegus* (not very common).

Kentish Plover. *Charadrius alexandrinus alexandrinus* L. (fairly common in suitable localities).

Lapwing. *Vanellus vanellus* L. (not common as a nesting species).

Redshank. *Tringa totanus* L. (nests in small numbers).

Black-winged Stilt. *Himantopus himantopus himantopus* L. (nests in varying numbers from year to year).

Avocet. *Recurvirostra avosetta avosetta* L. (common in suitable localities).

Black Tern. *Chlidonias niger niger* L. (fairly common).

Whiskered Tern. *Chlidonias leucopareius leucopareius* Temm. (found nesting in suitable localities).

Gull-billed Tern. *Gelochelidon nilotica nilotica* Gm., (nests in considerable numbers and said to be the only nesting place in France).

Common Tern. *Sterna hirundo hirundo* L. (fairly common).

Little Tern. *Sterna albifrons albifrons* Pall. (not so common as last).

Black-headed Gull. *Larus ridibundus ridibundus* L. (not common.

Herring Gull. *Larus argentatus michahellisi* (rare as nesting species.

Baillon's Crake. *Porzana pusilla intermedia* Herm. (rare).

Water-Rail. *Rallus aquaticus aquaticus* L. (not uncommon).

Moor-Hen. *Gallinula chloropus chloropus* L. (fairly common).

Coot. *Fulica atra atra* (common).

Red-legged Partridge. *Alectoris rufa rufa* L. (common).

IV

THE NORFOLK SEA FLOODS

February, 1938

Introductory

The object of this article is to give a comprehensive account of the cause and still more of the effects of the sea flooding due to the 700 yard breach in the sandhills, which occurred on the night of February 12th, 1938, between Winterton and Horsey Gap.

The effects of this inroad of the sea will no doubt be felt for many years, and at present it is only possible to record the immediate consequences. The area covered by the sea flood is shown in the map. The article is divided into three parts :—

I. Past history of sea flooding and the cause of the 1938 flood, by J. E. Sainty.
II. Mapping the flooded area, by J. E. G. Mosby.
III. General effects of the flood, by Anthony Buxton.
IV. Detailed observations, by E. A. Ellis.

I. Past History of Sea Flooding and Cause of the 1938 Flood, by J. E. Sainty

The disaster of February 12th, 1938, was but the latest, and it is to be sincerely hoped the last, of a long series of breaches of our all too frail coast defences.

The earliest breach of which there appears record occurred in 1287, when the floods swept inland to Ingham and Potter Heigham, reaching a level a foot higher than the altar of Hickling Priory, and drowning one hundred and eight persons in Hickling alone. The great abbey of St. Benets at Holme was saved only by the stout enclosing walls, whilst at Yarmouth most of the town was tide swept and the church flooded.

The beginning of the seventeenth century saw several breaks in the dune line at Waxham.

Blomefield records of 1608, " At this time there were such violent inundations occasioned by the high winds that incredible damage both to houses, men and beasts, was done in many parts of England, and in several places of this county, to such

a degree that an Act passed for the speedy recovery of many thousand acres of marsh and other grounds lately overflown, etc., in the county of Norfolk, and for the prevention of the like hereafter, which sets forth that a part of the sea shore lying between the towns of Great Yarmouth and Happisborrow (or Haseboro) lying low, and being sand only, was lately broken down and washed away by the violence of the tides, so that the sea broke in every tide, and with every sea-wind came up the Norwich river into the very body and heart of the county of Norfolk, drowning much hard grounds and many thousand acres of marsh, upon which great part of the wealth of the county depends, being most rich grounds, and without which the uplands, which are mostly dry and barren, cannot be husbanded, and by means of the salt water the fisheries between Yarmouth and Norwich, as well in rivers as in broads, were much damaged, so that the great plenty which used to maintain many poor men was gone, and the markets badly served with fresh fish . . . . Among the towns that were damaged are mentioned Possewick, Thorp by Norwich, Trowse and Carrow." Mrs. Ivor Hood records that in 1609 two thousand helpers were mustered to repair the defences. On December 27th, 1665, "a tremendous high tide" swept the dunes between Horsey and Waxham, doing extensive damage; whilst on the same date in 1791 very extensive sea-breaches occurred at Winterton, Horsey and Waxham, wide-spread floods resulting.

The opening years of the nineteenth century saw another danger period.

The following is taken from the correspondence column of the *Eastern Daily Press* of January 16th, 1937.

"Mr. Hewitt in his preface to his essay published in 1844 tells us that 'The Rev. John Hewitt B.A. Perpetual Curate of Walcot expended in the year 1802 upwards of one hundred pounds in an attempt to fill up at his own expense the worst breach existing between Waxham and Horsey . . . . But unfortunately, prior to the task being completed, a strong north-west wind upon a spring tide ensued, and a quantity of water passed through the breach partially repaired. A cottager residing near the place witnessed the circumstances only just previous to the irruption of the water and informed my

relative that had he possessed a shovel he could have prevented it . . . . The spot on that part of the coast to this day is recognised as Hewitt's Bank.' "

The following extract from the " Memoirs of the Geological Survey. The Geology of the country near Yarmouth and Lowestoft " by J. H. Blake, requires to be quoted in full.

" But for this natural barrier of sand-hills, fixed or united by the growth of the ' marram ' (Arundo arenaria) and other plants, the sea might enter and spread over 40,000 acres of land, as has been calculated. There are records stating that nine gaps or breaches were made through this embankment in 1792. They were measured by Mr. Faden, who ascertained that together they were 484 yards wide. On this occasion " a body of water passed through between Horsey and Waxham, extending beyond Hickling, a village situated three miles inland, which uniting with the fresh water contained in a large lake, termed the Hickling Broad, destroyed all the fish. The injury the land sustained in the immediate neighbourhood was very considerable"

" In 1805 there were again several gaps, and the whole together between Winterton and Happisburgh, measured nearly a mile. Mr. William Smith was engaged to repair them, and the way he set about it was eminently characteristic of his qualities as an engineer. After considering a variety of plans which had been proposed for stopping the breaches by timber ! by stone ! by clay banks ! etc., he examined the operations of the tides and storms on the coast, compared the levels of the high and low parts and finally proposed to make all the new artificial embankments as like as possible to the natural embankments thrown up by the sea (and wind) on the same coast, to make them of the same materials, and to give them such directions as might best shelter the new work by the old. A plan so simple was almost rejected with ridicule, till, by walking on the sea-shore and pointing out to his amazed companions how ineffectual and short-lived was the resistance offered by solid constructions to the rage of the sea, and how permanent was the power of sloping banks of sand and pebbles, in particular directions, to exclude the ocean which (together with the wind) had formed them he convinced the most sceptical . . . . By watching the aggregation of sand and

pebbles on the shore, he found that, at particular seasons and by unusual storms, the bed of the sea was disturbed, and the sand became covered by pebbles or 'shingle' scattered with much uniformity. These shingle beds were effective in binding down the sand which would otherwise have drifted with the wind, and he resolved in this respect to imitate his great teacher—Nature. Accordingly carts in great numbers were employed in removing sand and making great mounds across the gaps, and then, especially when the tides threw up shingle, the sandy bank was sealed down with a bed of pebbles. On these unresisting slopes the mightiest storms of the German Ocean now break harmless, and a very slight annual charge is sufficient to maintain the form and substance of the work . . . . The repairs of the breaches in the sand hills, between Winterton and Happisburgh, extending altogether over a mile in length, were accomplished in 1805 in almost a single summer, and thereby "the expulsion of the sea from seventy-four parishes in Norfolk and Sixteen in Suffolk, which, by an act of James I, 1610, entitled 'The Norfolk and Suffolk Sea Breach Act' had been declared liable to contribution."

The great gale of November 28th to 30th, 1897, which did tremendous damage all along the east coast, caused an extensive breach in the sand hills at the Hundred Stream, with serious flooding. The Sea Breach Commissioners, selected from landowners liable to flood, received severe criticism, particularly for not preventing the removal of beach material from Walcot, and the cutting of the marram grass for thatching.

In the preparation of the historical notes I wish to acknowledge the valuable and courteous assistance of the City Librarian, Mr. G. Hayward, F.L.A.

CAUSES OF THE FLOOD OF 1938.

East Norfolk, of which Horsey forms part, appears to have been, a thousand years ago, an area of small islands, elevated only a few feet above the marshes and sand banks, seamed with channels through which the sea at high tide had access. One of the largest of these channels was the wide flat in which lay the Hundred Stream, and across the seaward end of this flat some two centuries ago, an artificial bank was constructed to protect from inundation the area, which by the natural formation of sandbanks, pebble-beds and dunes, together with

the silting by the sluggish streams, had been gradually transformed into land. The Hundred Stream, in the long past days when it had direct access to the sea, behaved like the lower reaches of any East Norfolk river, ebbing and flowing with the tide, running inland as the tide entered, and draining to sea with the ebb. Under such conditions indeed it was doubly tidal, experiencing its maximum with the local high tide, and later receiving the " back shock " as the tide came up stream from Yarmouth. The term " stream " would then be a misnomer, for it would actually have been merely the deepest part of a wide shallow channel. With the closing of the dune line and the draining of the marshes the Hundred Stream lost all functional significance, for the present drainage is entirely artificial, the pumps lifting the water to discharge by the main dykes via Potter Heigham to the sea at Yarmouth. Now the Hundred Stream is separated by deep drains from the land on either side and appears as a very shallow trough in the centre of a bank elevated above the drained marsh lands. This bank now serves the purpose of a water parting, separating the distinct drainage areas of Somerton and Horsey. Though the banks enclosing the trough of the stream are obviously artificial, yet the apparent elevation seems chiefly due to shrinkage of the drained marshlands, for Mr. Arthur Dove of Horsey tells me that his grandmother, who died in 1920 almost a centenarian, remembered in her childhood seeing boats sailing up the Hundred Stream, then, as now, shut in from the sea. To-day indeed the Stream possesses no gathering ground for its waters, but the sudden splaying out of the enclosing banks as they approach the dunes suggests that their object was to allow the surplus rainfall of the Warren (a belt of land 500 yards wide, and covered with rough grass, which lies just inland of the sand dunes) to find its way into the Hundred Stream and so into the Thurne ; now no water flows, and the Hundred Stream, like some of the Fenland rivers, is left stranded by the shrinkage of the surrounding drained land.

The immediate cause of the disaster of February 12th, 1938, was obviously the inability of the bank across the Hundred Stream, weakened by wind-drift of its sand and by wave erosion, to withstand the attack of the storm-driven breakers at a period of exceptional high tides. The beach had never

[*Photo, Eastern Daily Press*

The Breach from the Northern end

recovered from the disastrous effects of the great gale of the first of December, 1936, when the sand was swept away to such an extent that Major A. Buxton saw on the exposed clay surface, fifty yards to seaward of the sand dunes, the hoof-prints of unshod horses and of cattle, as well as the foundations of walls. It seems that these tracks must have been covered, perhaps suddenly, by inward movement of the sand, at a date when the dunes were at least a hundred yards to seaward of their present position and when the farm with its animals was inside the line of the hills. The tracks appeared so perfect that it is probable they had remained covered and so protected by the sand until exposed by this gale in 1936. No steps had since been taken by the responsible authorities to attempt to build up the beach level or to replace the lost material.

Behind the immediate cause lie others more fundamental, particularly the changes in the relative levels of land and water in the region of the North Sea. The second geodetic levelling of the Ordnance Survey, 1912–1921, was based on Newlyn, the new mean sea level zero being approximately five inches below the old Liverpool datum, but the new levellings do not by any means show this constant five-inch difference from the old. From Edinburgh to Lancaster the new readings are higher than the old, but southward the values are lower, varying from a few inches at Macclesfield to two feet at Harwich. In the Horsey area the new levels appear eighteen inches lower than the old figures, a difference considerably greater than can be accounted for by the five-inch datum change, or even by accumulation of observational errors. The evidence suggests a definite tilting movement, resulting in the elevation of the north and the depression of the south. Recent scientific observations confirm the view that Scandinavia is rising and Holland is sinking.

But the evidence of changing level is not confined to modern observations ; it can be traced back to Roman times, for the tesselated pavements of Roman Thames-side villas are now below river level, and Roman wharf sites are permanently submerged. The Fenland Research Committee's investigations have demonstrated that the land on which mesolithic hunters dwelt seven thousand years ago is now seventeen feet below sea level. The lovely bone harpoon or fish-spear, dredged up

off the Leman sands and now in Norwich Castle Museum, was lost by its mesolithic owner in swamp or shallow water; whilst the cave at Oban, inhabited by similar hunters at a time when the breakers could occasionally sweep into it, is now high above the surf.

The level of the Horsey area has undergone many changes in times that the geologist looks on as recent. More than once it has formed part of the bed of the North Sea; at other times it has been raised forty feet above sea level, only to be again depressed. The present phase seems to belong to a period of land depression, slow and long-drawn, but tending ever to sink lower at the end of each movement. A simple explanation of the phenomena is to be found in the realisation that the land masses are floating on deep-seated, relatively denser layers, like planks on a pond. If one end of a floating plank is pressed steadily down, there will be a compensating rise at the other end, the volume submerged remaining approximately constant. If this downward pressure is suddenly removed, the depressed end rises abruptly and the elevated end correspondingly sinks, and a series of damped oscillations is set up, each end alternately rising and falling, the movements becoming less extensive, until equilibrium is again attained. A similar series of movements appears to have occurred and, indeed, to be still occurring in the case of the land areas about the North Sea. The initial movement of depression on the north may have been due to the weight of the enormous mass of ice accumulated there during the oncoming of the last glacial episode, whilst the apparent elevation of the southern area would be accentuated by the actual lowering of the sea level, due to the removal of the great volumes of water in the form of ice. When this great ice mass melted, the resulting lowering of pressure enabled the northern lands to rise, with corresponding depression of the south, made more obvious by the rising water level. Such in very brief outline appears to be the simplest explanation of the observed phenomena, and, though serious objections have been raised, based on considerations of the resultant strains in the floating land masses, no alternative suggestions appear to explain matters as satisfactorily.

In the Horsey area the land and sea levels are now so nearly the same that equilibrium may easily be disturbed. An

abnormally high tide will tower above the marshlands and only the stability of the sea bank can defend the district from inundation. Mr. N. G. Parkinson has stated clearly the complex sequence of conditions necessary for maximum tides at Horsey. First there must be a prolonged south-westerly gale driving on the eastward-flowing currents of the North Atlantic, followed by a sudden shift of the wind to northwest about the Shetlands to divert the currents into the North Sea basin, whilst continuing southwest winds in the Channel hinder the discharge of the piled up waters. Finally, for maximum danger, Mr. Parkinson postulates a sudden shift of the gale to the north-east immediately before high tide, so flinging the great breakers directly on to the beach. However, local opinion is strong that at spring tide, the continuance of the north-west gale, piling still higher the North Sea waters, is even more dangerous than the shifting wind.

A long spell of off-shore wind tends to build up the beach levels, but the loose sand, unless consolidated and bound down by shingle, cannot long resist the attack of the waves driven by an along-shore wind.

The action of the sea on a wasting coast is threefold—denuding, transporting, and aggrading. The chief agents are the waves, for on this gently curving coastline, flanked by a shallow sea, the effect of currents is practically confined to transporting southwards a suspension of the finest materials carried out by the ebbing waves. The ordinary waves are responsible for the longshore drift of somewhat coarser material, for they approach the beach from the northeast and ebb to the southeast, the track being like the outline of the teeth of a saw. The velocity of approach is greater than that of recession, so that the breaking wave tends to fling up the beach coarser material than the ebbing wave withdraws, but this building action is limited, as the steepening of the slope by the constant withdrawal of the finer sediment allows some of the pebbles to slide back below tide mark. The great mass of the material is thus rolled obliquely up the beach and then obliquely down, moving continuously from north to south, so that any particular area of the coast is ever losing part of its beach material to the south, and as steadily receiving fresh supplies from the north.

The case of the great wind-driven storm breakers is different. The fury and speed of their approach enable them to hurl comparatively large pebbles up the foreshore, pebbles of a size that the ebb fails to remove, and thus these waves are responsible for the building up of embankments, which tend to resist ordinary denudation and provide cheap and efficient coast protection. The danger is that, on a dune-defended coast, these breakers may attain such a height that they may overtop the dunes and so breach the defences, as actually happened in February. The size of the breakers is determined by the size of the waves some distance off shore, and by the loss of energy as they traverse shallow water. Thus the best means of preventing the breakers from overtopping the dunes is in the height of the beach itself, for the shoaling water causes the waves to break whilst still some distance out.

The highest storm waves at Horsey approach the shore obliquely, when the northwesterly gale, having piled up the flood tide, suddenly swings to the north or north east. The impact thus occurs first at the northern end of the wave, and it is there that the battering effect will be most pronounced. There will be, therefore, a steady tendency for the coast line to be adjusted until it is parallel to the line of the heaviest storm waves, and the denudation on the north and the piling up of beach material on the south will be likely to continue until this is attained.

The supply of fresh beach material at Horsey depends mainly on the rapidly wasting cliff-line southeast of Overstrand. This wastage is only to a limited extent due to the action of the sea, but depends mainly on the structure of the cliffs themselves. They have been aptly described as a "fossil glacier," for the "contorted drift," which forms so prominent a feature of the cliff section, actually reproduces the tortuous structure of the moving ice stream. The great ice sheet, with its inclusions of sands, clays, and gravels, was pressed forwards by the weight of the northern ice mass. At frequent intervals in its southward progress the "ice nose" (the edge of the moving mass), froze to the frozen ground and presented an immovable obstacle. The ice behind, forced on by the immense pressure, was compelled to slide up and over the frozen mass in front and the switchback motion was repeated again and again. When

finally, with the ameliorating climate, the movement ceased and the ice slowly melted, the contained debris retained the curved structure thus imposed on it.

The sea, between Cromer and Mundesley, now cuts obliquely across the eastern end of the ridge thus piled up, the cliff sections showing clearly the complexity of its structure. In those parts where the ice, in its southward journey, was mounting the obstacle, and climbing up inland, the strata now slope downwards towards the beach. As the clay seams become wetted by percolating rain, they allow the superincumbent masses to slide and one of the great cliff falls occurs, the debris covering the beach and extending far below tide mark, until the longshore drift has carried it southward. These cliff falls provide the main supply of fresh material for the aggradation to the south. On the other hand the coast will remain stable at the spots where the ice, moving in from what is now the sea, had surmounted the obstacle and was descending its inland side, for the strata slope from the cliff face in towards the land, and cliff falls and denudation will be at a minimum.

Two other aspects of the sea's activity on this coast are of importance. The first is the tendency for the formation of submerged sandbanks more or less parallel to the shore. This is indeed a characteristic feature of the southern borders of the North Sea. Such banks afford considerable protection during on-shore gales. In Holland the stabilising of such submerged banks and to some extent the power to assist and direct their formation has been shown to be possible by the use of "fascine mattresses"—two layers of brushwood, each composed of crossed rows of parallel brushwood ropes bound tightly together, with three layers of brushwood filling between them. Openwork partitions are formed so that the mattress may be weighted with stone ballast. It may be found possible to apply this method to our own coast.

The other activity is the formation of "lows," along-shore channels, often of considerable depth, parallel to the coast line. These may be formed well up the beach, and the effect of a sea wall, whether a rigid line of concrete or piling or a yielding line of sand or pebble banks, is usually to increase this tendency, by directing the current along its own foot.

In fact " the immediate effect of a sea wall is detrimental to the beach in front of it, and the wall may become before long the agent of its own destruction " (N. G. Gedge).

The main natural defence against abnormally high tides has been provided by the wind-formed dunes. Frail as these appear, they provide a surprisingly effective barrier, provided that they are not overtopped by the breakers. In that case the water descending on the landward slopes rapidly weakens the dune and enables a breach to be formed. The best defence of the dunes is clearly to so build up the beach in front that the waves break well off shore. The sand dunes travel with the prevailing winds, but under the binding power of the marram grass they become comparatively stable.

Coast Defence

Coast defence needs only brief reference, since the publication of Mr. S. W. Mobbs' report shows that a thorough and far-reaching scheme is contemplated. The immediate task of closing the breach seems to have been satisfactorily accomplished by the wall of steel-pinned concrete bags, though this has yet to face its first real ordeal of abnormal high tide with northwesterly gale. However, the wall needs the protection of the interlocking steel piles, (for concrete is apt to wear under the impact of breaker-flung pebbles), and the further and even more essential protection of a high beach. This is more difficult to provide, for, as Mr. Mobbs points out, " millions of tons of sand had been removed, not only from the bank but from the beach itself during last winter's gales and had permanently disappeared." There is little likelihood that any of the material which has once been carried south by wind or current, or below tide level by the ebbing waves, will be recoverable, whilst the paucity of sand on the dunes to the north, the continuous carting away of beach material at Walcot, and the cutting off of supplies as coast protective measures prove effective between Overstrand and Eccles, all tend to reduce supply of material available. The sand for the construction of the bank has indeed to a large extent been taken from the beach immediately adjacent to the danger area, and this, however great may have been the needs of the moment, must have a deleterious effect.

The attempt to collect sand by faggoting the beach at the foot of the dunes failed, for wind driven sand can travel effectively only over a dry beach, and as the average tide line is only fifty feet from the bank, but little collecting area is exposed. The most effective way of strengthening and building up the beach must be looked for in a system of cross-groynes. This has already been begun, and the main question is how far it can be made effective before the winter gales set in.

Beyond the immediate area of the breach, the zone of weakness extends four thousand feet to the north and two thousand four hundred feet to the south. Throughout this length the necessity for stabilising the dunes and protecting the beach is obvious. The denudation of the dunes can best be checked by the binding action of the marram grass, and it appears essential that access to the threatened area should be drastically restricted, for trampling feet injure the marram and the gusty winds soon blow away the sand. The spot where the breach occurred was perhaps the least frequented area of the Norfolk coast, but the repair work has now attracted visitors and further north towards Eccles the steadily increasing summer population makes immediate action desirable. In a prohibited area it should be possible to encourage the growth of other sand-binding vegetation to supplement the work of the invaluable marram. The protection of the marram should not prove to be too difficult, the provision of a few duck-board gangways or bridges, chained together and anchored against a sudden sweeping tide, would serve to canalise the traffic and discourage the meandering which opens innumerable tracks. A single strand of wire, reinforced by public opinion, would serve to discourage trespassing on the dunes themselves. The duckboard bridges could be shifted along to fresh sites at intervals to allow the trodden areas to recover. The dune foot may need concrete bag protection until the building up effect of the groynes has had time to show some result. The greatest of all dangers is delay.

Finally we may remember the dictum that " it is not desirable, even if it were practicable to prevent erosion of all parts of the coast, as the waste of the cliffs provides the greater part of the beach material which acts as the most valuable agent of protection."

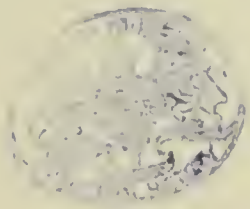
II Mapping the Flooded Area

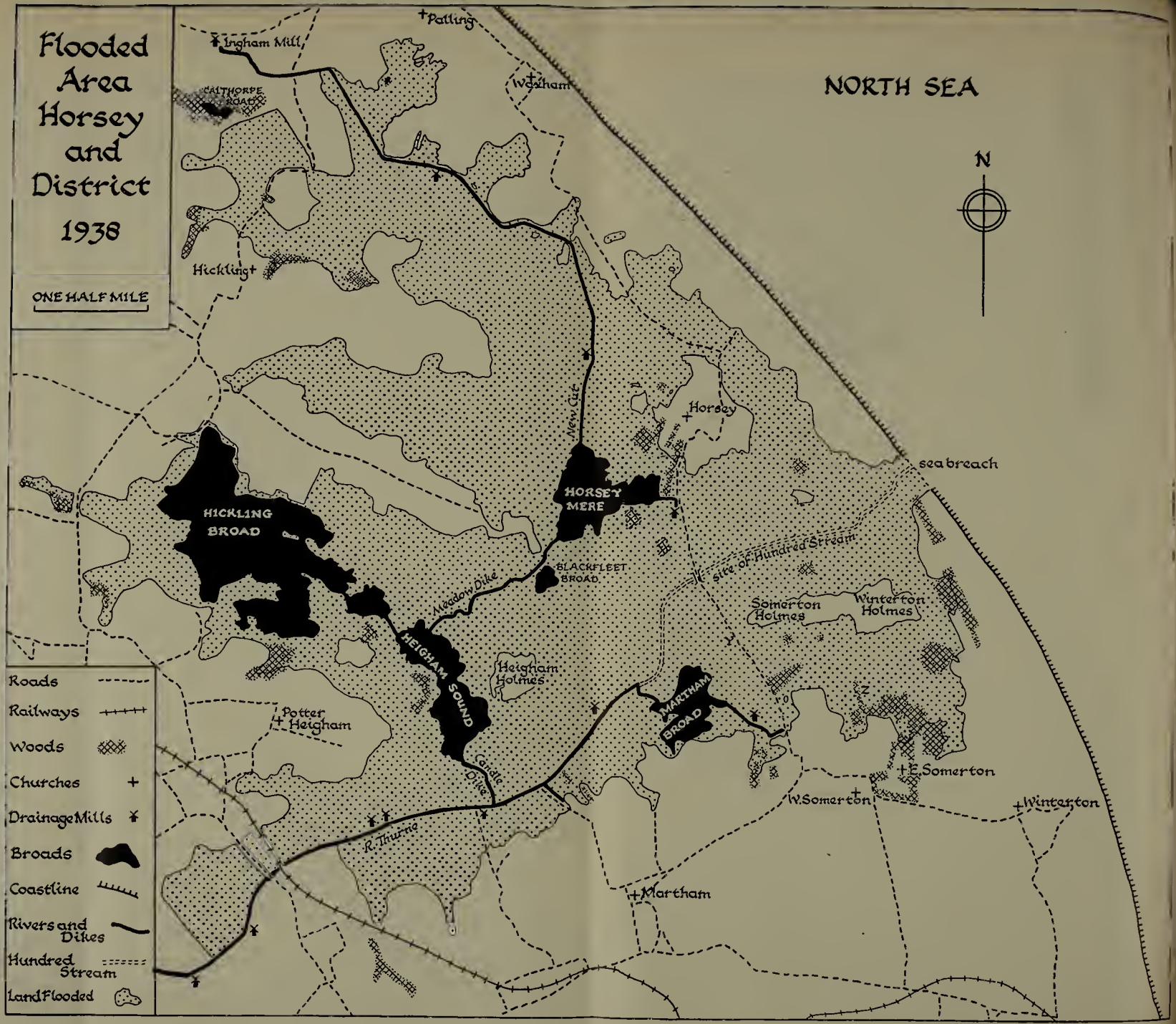
By J. E. G. Mosby

The task of mapping out the fullest extent of the 1938 floods in Horsey and the neighbouring parishes presented a number of difficulties, due in the main to the fact that the floods were beginning to subside in some parts before they had reached their fullest extent in others. For example, on Feb. 13th, the water began to creep over the road situated close to the north-west corner of Hickling Broad. On the following morning this road was impassable, the flood water having completely covered it to a depth of a few feet and penetrated beyond into the margins of the neighbouring fields and gardens, but before nightfall an appreciable fall in the level had taken place. In this place the height of the flood was reached on the 14th, while the water travelling up Waxham Cut rose a further 4½-ins. between the 14th and 16th, when it reached its maximum height at the Ingham Drainage Mill. At Potter Heigham the maximum extent of the flood was reached on the 17th, one day later than at Palling Mill and three days later than at Hickling. The details of the approach of the flood at Potter Heigham are of interest. On the edge of a lane between the railway station and the church, there was no flooding on the 13th, and the water did not arrive there until the following day, when it made its appearance by penetrating slowly up the dykes. By the 16th the floods were described here as bad, but the water continued to rise for yet another day, the 17th.

In some places the "shore line" altered considerably in the course of a few hours, due to the force of the flood or the action of strong winds. Owing to the former small areas of comparatively high ground, situated on the line of the oncoming water, were covered for a short time only—i.e., while the flood waters swept over them. Owing to the action of strong winds some of the fields adjacent to those already flooded were affected. Local inhabitants have pointed out fields which were dry in the morning, covered by a shallow sheet of water at noon, and clear again by the evening.

In the parishes of Palling, Waxham and Martham, water crept up the drains and through pipes under roads into detached areas of low lying land. In the majority of cases, attempts were made to block up the pipes, but these efforts proved




Flooded Area Horsey and District 1938
ONE HALF MILE
NORTH SEA
N
Ingham Mill
Palling
Ingham
Calthorpe Road
Hickling
New Cut
Horsey
sea breach
HORSEY MERE
HICKLING BROAD
BLACKFLEET BROAD
Meadow Dike
site of Hundred Stream
Somerton Holmes
Winterton Holmes
HEIGHAM SOUND
Heigham Holmes
MARTHAM BROAD
Potter Heigham
Candle Dike
R. Thurne
E. Somerton
W. Somerton
Winterton
Martham
Roads
Railways
Woods
Churches
Drainage Mills
Broads
Coastline
Rivers and Dikes
Hundred Stream
Land Flooded

ineffective and merely resulted in delaying the arrival of the floods. Such is the irony of the situation that the measures designed to prevent the land from being water-logged were the very instruments which brought about its inundation. It is obvious that once the flood water was able to penetrate into any drainage level, almost the whole of that level would suffer.

The question of using air photos for the purpose of mapping the flooded areas was considered, but in the light of the observations already made nothing short of a series of vertical photographs taken twice every day for at least a week would be sufficient for the purpose. The map was made from observations taken on the ground, by walking round with somebody who knew the district thoroughly during every phase of the flood. The shore line was mapped out and checked with all available sources of information, and I am particularly grateful to Mr. Jim Vincent who walked round with me, and to all those who helped me—with maps already made or by indications on the spot—to trace the actual line.

The total area flooded at one time or another was approximately 7,500 acres, the depth varying from a few inches on some of the margins to over 8 feet in some of the deepest parts. The areas on the east, particularly near the Hundred Stream, received much greater damage than that situated near Potter Heigham Bridge. In the Eastern area the floods attained their greatest depth, and water remained on the land for the longest period. Here fences, gates, stacks of hay and reeds, etc., were swept away by the force of the advancing flood, and a bridge which connected Somerton Holmes with the Horsey coast road was carried bodily for three-quarters of a mile. (Its original position is marked "Y" on the map and the spot where it was caught by the trees and remained suspended is marked "Z.") The banks in the track of the flood were strewn with debris, such as farm gates, posts, bits of wire-fencing, pieces of wooden sheds, bundles of reeds, etc.

The distance round the margins of the flooded area was 43 miles, excluding islands, whose length of shore line was 9 miles, and it should be clearly understood that this "shore line" owing to the action of wind, force of the flood, and artificial barriers, cannot be regarded strictly as a contour line. In many places the water was held up by hedge banks,

river walls, roads, etc. The shape of the shore line was therefore determined partly by the configuration of the ground and partly by artificial barriers; the latter being readily distinguished by straight lines.

The scale of the map reproduced in this issue of the Transactions is too small to show the finer details which are given on my original, drawn on a scale of 6-ins. to one mile and deposited with the Norfolk Research Committee.

Land Utilisation. The flooded area consists of marshes below the level of the river, from which the surrounding "upland" rises to a height of 50 feet or so; while within the marshland area itself there are a number of small areas of higher ground which stood out as islands during the floods.

Many of these "islands" or "Holmes" have at some time or other been used as arable land, and the greater part of the arable land of the flooded area is situated on their margins, or the margins of the outer "shore line." The marshes in the main are used for summer grazing, osier beds are quite a common feature, but a considerable portion of the less accessible marshes have become overgrown with reeds, partly because reed growing pays on a poor marsh, better than grazing.

In assessing the land use of the flooded area I have considered both the actual use of the land immediately before it was flooded, and the use to which the land was put when farming was in a more happy position.

Classification of Land Flooded

Land Use.	1932—1937.	about 1900.
	acres.	acres.
Arable	752	1500
Grazing ground	3459	4000
Osiers	47	30
Woodland	174	150
Rough Ground	1660	429
Buildings, Gardens, etc.	86	60
Broads, Reeds, Ronds—including Brayden Marshes	1291	1300
Total	7469	7469

Notes.—Nearly all the land classified as "rough ground" was formerly farm land, i.e., arable or grazing ground, which had by 1937 become overgrown with reeds, rushes, etc.
The figures for 1932 are based on the recent Land Utilisation Survey, while those for 1900 must be regarded as a very rough estimate only.

III. General Effects of the Flood

By Anthony Buxton

An inland sea that turned into a desert is my general impression of the flood, and its worst feature the resulting lack of life. The process of natural recovery will prove interesting, but the devastation and the general air of a great flat rubbish heap on which nothing can thrive, produce a feeling of intense depression. The limit between flooded and unflooded area was during the spring and summer blatantly abrupt—from bright green life to red brown death; the contrast between red and green was reminiscent of an impressionist picture, and a bad one at that. There may have been, and indeed there was, some beauty about the floods, particularly at sunrise sunset and by moonlight; there was none in the aftermath.

Getting Rid of the Flood

In order to make understandable to those less familiar with the district what occurred at and after the flood, and what happened to the sea water that came in through the breach, some description of the local drainage system seems required. None of the water in the affected area finds any immediate or direct exit to the sea. It only reaches the sea at Yarmouth after a circuitous course of about twenty miles along a system of banked up dykes and rivers. There is no natural fall from the land, which can only be drained by pumping the water from the dykes surrounding every marsh and field by windmill or engine up into this high level drainage system.

The breach in the sea defences that occurred on the night of February 12th let in such a volume of sea water on to the land that it poured directly off the land over the tops of the banks into the broads and main dykes. Luckily, very luckily, these waterways were not brimful at the time and were therefore able to take up and let away towards the sea at Yarmouth a large volume of water, which in fact entered Norfolk at the breach and left it at Yarmouth unassisted by man. If this had not been so—that is if these broads and main dykes had been brimful at the moment of the breach—the sea flood might have swept much further in its first rush. Hickling and Potter Heigham for instance, as well as other places, might well have been inundated at once. Mr. Sainty's account of

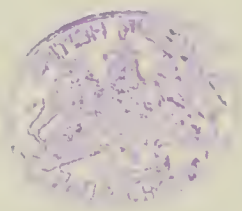
previous floods has shown what might have happened, even as far as Norwich. The effect of a really high tide is felt on the broads about two days after it occurs at sea. It hits us, so to speak, in the back, via Yarmouth and Acle. By the time this push in the back was felt, much of the water coming in from the breach, had already got away down the rivers. The area flooded was regulated and would always be regulated not only by the extent of the breach in the sea defences and the direction and strength of the wind and state of the tide, but also by the capacity of the high level inland water system to take in some of the surplus sea water.

The flow of water from off the land into the high level system was helped and hastened by the opening of numerous cuts or 'grups' through the banks or walls guarding the edges of the broads and high level dykes. When the level of sea water covering the land was thus lowered these cuts were deepened and more water run off, but this process could not be continued beyond a certain point. It had to cease when the water level on the land had been dropped to the water level in the broads and in the dykes connecting them. There was a further complication. The water level on the broads and in the high level dykes varies according to wind and tide, owing to the banking up of the rivers by tidal action. In a perfectly dry period for instance there may be a rapid variation of two feet in the level of the water in Horsey Mere according to the direction of the wind and the state of the tide. South East wind drops the level, North West wind raises it. North East and South West winds are neutral. Naturally therefore the water level in the broads after the flood was continuously changing according to wind, and this necessitated sometimes deepening, sometimes closing the cuts in the bank. The closing often had to be done in a great hurry to prevent a flow back from the high level system onto the land. Eventually the position was reached at which no more water could be run off the land in this way, and the rest had to be pumped from the land up into the high level system—the normal drainage process in the area.

The position may be clarified by a homely illustration. If Horsey Mere, to take one example, be considered as a bath and the surrounding land as a bathroom, the sea water entered

The land beginning to reappear. Somerton Mill

[*Photo by A. A. Francis, Martham*



by the bathroom door (the breach) and filled the bathroom to a level higher than the rim of the bath, into which of course it flowed. The waste pipe, Meadow dyke, acted well (as it always does) in a South East wind, when the rivers are not banked up by the tide, but the water flowed (as it always does) back up the waste pipe in a North West wind. Slits were cut in the rim of the bath to ease the situation in the bathroom, until the level of the water in the bathroom was reduced to the level of the water in the bath. When the level in the bath dropped the slits were deepened, but had several times to be closed again, when owing to the action of wind and tide, the level in the bath again rose. Then came the moment when the water in the bathroom was lowered too much for the slits to be effective, and the rest of the water from the bathroom (far the greater bulk of it) was *pumped* into the bath. Whilst the bathroom door was open or only partially closed, a condition which lasted for nearly three months, both the slits in the rim of the bath and the pumping could ease the situation, but that was all; only when the door was closed could the bathroom be pumped dry. The bathroom floor, although dry since May, is still impregnated with salt, and the bath water is also salt, but slowly becoming less salt month by month.

Mr. Jim Vincent has kindly sent me the following account of the valuable work which he and his men performed at Hickling :—

"The sea flood which covered the land at Horsey, Somerton, Heigham Holmes, and the east side of Waxham menaced Hickling and Potter Heigham by filling up Horsey Mere, Heigham Sounds, and Hickling Broad, to a height unknown in living memory.

"The walls or banks surrounding these parishes never had much margin of safety during abnormal high tides, and after the breach occurred the water rising daily demanded quick action. On Sunday February 13th, it was obvious that Hickling might be badly flooded. I had left a message early in the morning for men to raise the walls where required, and upon my return from Horsey sent out an S.O.S. for others. We toiled until dark. The water continued to rise from the 14th until the 17th, when the position looked hopeless. Along a four-mile front of walls earth was dug and piled on top of the banks, but whole lengths kept washing away, the water

cascading in torrents over the walls, which we had to remake in order to check the flood to the best of our ability. Since the water was pouring over the wall between Waxham and Hickling, the north side of Hickling was drained off, a move which at first aroused some objection but proved to be wise and to have saved much flooding of fresh ground.

"On the morning of February 18th, the wind died away and the water dropped nearly an inch. Potter Heigham bridge had been holding the water up on our broads and preventing it from getting away. Moreover the sea had been coming through the breach every day. We had prevented over three feet of water coming into Hickling, which would have put much land out of cultivation and contaminated many wells in the parish."

The following question may well be asked:—"Why did not the sea water that flowed in through the breach flow back again at low tides into the sea through the breach as long as it was open?" The answer is that the sandhills are the water-shed, and once over that barrier, the water flowed downhill inland to cover the lowest marshes. There was practically no water standing for several hundred yards inland of the breach, and the strip of land known as the warren lying inland of the sandhills was almost entirely free of sea water during the whole period of flooding. The marshes and much of the arable are at a lower level than the warren. The greatest depth of flood water lay about a mile West of the breach—roughly on the line of the Hundred stream and on either side of it between Somerton and Horsey.

Since the first two attempts to close the breach entirely failed and the temporary works were swept away, the breach was not actually closed until the middle of April and the flood water was not reduced to dyke level until early in May, the Somerton area being the last to be cleared. If extensive repairs had not been done to the river bank on the Martham level in 1931, this area would have suffered much more severely. The flood water was drained off this level in twenty-eight days.

During the first stages of the pumping, which was conducted by engines and windmills working without interruption day and night the extent of water to be pumped was so great that the drop was less than an inch in twenty-four hours. But as the area of water was reduced the pace of the drop

increased from an inch to two inches, from two inches to three. Finally, when the tops of the dead rush and grass on the marshes began to appear, the flood seemed to go with a rush, and a loathsome stream of thick reddish yellow water swirled out of the dykes through the mills into the rivers and broads. There gulls collected in large quantities to make a cheap meal of the sprats and other sea fish that had come in with the flood and were choked in the process of being bustled and battered through the mills. A great debt of gratitude is owing to the millmen, who pumping day and night got the flood water out in the shortest possible time.

The scene as the water receded off the marshes was of a red brown desert, with rubbish of every kind littering the marshes trees bushes hedges and gates, devoid of life except where a few pools that still contained the remnants of creatures from the sea produced a temporary feeding ground for waders. The odour was that of a rather stale salting, and the general impression a dead and smelly waste.

Salinity

The Norfolk Fishery Board have had water samples taken regularly since the flood by Mr. A. J. Rudd from the broads and rivers affected, and the attached table is compiled from the information kindly furnished to me by Mr. Ernest Bullard, Chairman of the Board.

The reader of the table as his eye travels *across* the page from left to right should imagine himself going inland and, except for a diversion to Hickling, downstream. As his eye travels *down* the page, he can follow the slow process of washing out the salt in the different localities month by month. The salt spread slowly from East to West, so that at the end of May the maximum salinity was registered at Hickling, when it equalled that at Horsey. The maximum salinity at Martham Ferry, Potter Heigham, and Thurne Mouth also occurred at the end of May. By June 10th there was a drop in salinity all round, but it was very slight at Hickling, which had then become more salt than Horsey.

After the table on the next page had been completed readings for Jan. 16th were received, showing a sharp decline in salinity after a long period of rain. The readings are: Horsey Mill Staithe, 7.89 $^{0}/_{00}$. Horsey Mere, 3.51 $^{0}/_{00}$. Hickling Broad, 4.68 $^{0}/_{00}$.

TABLE.*

Date	Horsey Mill Staithe		Hickling Broad North End		Martham Ferry		Potter Heigham Bridge		Thurne Mouth	
	Depth Metres	Approx Salinity 0/00	Depth Metres	Approx. Salinity 0/00	Depth Metres	Approx. Salinity 0/00	Depth Metres	Approx. Salinity 0/00	Depth Metres	Approx. Salinity 0/0
Feb. 20	0.0	31.27	0.0	6.58	0.0	17.55	0.0	18.73	0.0	3.00
	1.1	32.29	0.8	7.83	—	—	1.0	29.58	—	—
Mar. 3	0.0	19.6	0.0	10.01	0.0	16.96	0.0	18.13	—	—
	1.0	25.75	1.0	13.75	1.0	18.72	1.0	23.40	—	—
Mar. 15	0.7	27.49	0.7	15.59	—	—	—	—	—	
Mar. 30	0.0	27.49	0.0	16.96	0.0	18.30	0.0	20.23	0.0	6.85
	1.0	27.49	1.0	16.96	1.0	19.46	1.0	20.44	1.0	6.43
May 27	0.0	23.98	0.0	23.40	0.0	19.00	0.0	23.98	0.0	5.85
	1.0	24.27	1.0	23.69	1.0	18.72	1.0	24.27	1.0	6.43
June 10	0.0	18.35	0.0	21.64	0.0	9.00	0.0	14.74	0.0	2.57
	1.0	19.89	1.0	21.64	1.0	9.16	1.0	14.74	1.0	2.51
July 22	0.0	19.04	0.0	19.19	0.0	12.87	0.0	12.88	0.0	0.59
	1.0	19.57	1.0	21.65	1.0	13.16	1.0	12.75	1.0	1.76
Aug. 6	0.0	19.31	0.0	21.06	0.0	11.70	0.0	12.29	0.0	1.05
	1.0	19.31	1.0	21.06	1.0	12.29	1.0	12.87	1.0	1.20
Aug. 19	0.0	31.31**A**	0.0	18.72	0.0	4.95	0.0	6.55	0.0	1.23
	1.0	18.14	1.0	18.84	1.0	5.02	1.0	7.32	1.0	1.17
Sept. 2	0.0	16.38	0.0	17.14	0.0	9.35	0.0	8.19	0.0	1.40
	1.0	16.67	1.0	16.97	1.0	9.35	1.0	8.78	1.0	1.50
Sept. 16	0.0	15.80	0.0	16.38	0.0	3.51	0.0	7.61	0.0	1.17
	1.0	15.80	1.0	16.30	1.0	3.73	1.0	7.78	1.0	1.17
Sept. 29	0.0	14.27	0.0	13.43	0.0	5.68	0.0	6.73	0.0	1.10
	1.0	14.27	1.0	13.10	1.0	5.85	1.0	7.12	1.0	1.09
Oct. 14	0.0	12.82	0.0	11.70	0.0	5.85	0.0	6.10	—	—
	1.0	12.82	1.0	11.76	1.0	5.91	1.0	6.02	—	—
Oct. 28	0.0	11.70	0.0	11.70	0.0	4.21	0.0	11.70	—	—
	1.0	11.23	1.0	11.70	1.0	4.39	1.0	11.52	—	—
Nov. 25	0.0	12.87**B**	0.0	9.48	0.0	7.75**C**	0.0	6.18	0.0	8.19**C**
	1.0	12.99**B**	1.0	9.71	1.0	7.61**C**	1.0	5.97	1.0	8.19**C**

NOTES.

A.—High salinity on surface due to windmill in high wind pumping salt water out of dykes at moment of sampling.

B.—Engine pumping salt water out of dykes at moment of sampling. A sample taken from the middle of the Mere on the same day was 8.00°/00.

C.—High salinity caused by large salt tide that had occurred just before sampling.

* NOTE—Before the flood the salinity figure for Horsey Mere varied between 1.5°/00 and 2.°/00; that for Hickling Broad was 1°/00 or less. Samples taken from dykes at Horsey varied considerably in different dykes, some showed salinity as high as 9.4°/00, others as low as .3°/00 The greatest salinity seemed to exist in dykes at the foot of arable land, and the least in dykes surrounded by reed or rush marshes. Nearness to the coast did not necessarily mean increased salinity.

The salinity of the North Sea off the Norfolk coast is about 31.°/00

Tidal action as well as rainfall has affected the salinity in the high level system after the closing of the breach, and there is, of course, a perpetual movement of water great or small going on all the time both in the broads and the connecting waterways. Salt water from the affected area for instance travelling down towards Yarmouth may be pushed by tidal action up the Bure and Ant, as in fact occurred. Again, tidal action may push fresh water that has come down the Bure, the Ant, etc., up the Thurne. This effect was very marked on the Thurne at the end of August and resulted in a volume of fresh water sweetening the river above Martham Ferry up towards Martham Broad, so that the water in that channel was much fresher than the water in Horsey Mere. Springs fed from the Martham-Winterton ridge have also kept the water in the marshes in that area fresher than the water at Horsey. Numbers of fresh water fish were seen near Martham Ferry at a time when no fish could have lived at Horsey or Hickling.

Heavy rains are gradually sweetening the dykes and broads, but there is so much salt to be washed out of the land and waterways that the process will necessarily be slow.

Mr. Paul Hans of University College, London, reported as follows on samples of dyke water taken at Horsey after the flood had receded. "The muddy deposit is almost black, but on drying acquires a rust colour. I can find no evidence of *Crenothrix* or other iron bacteria, but the deposit certainly contains iron, probably as hydrated oxide, and in addition some carbonate and sulphide ; the latter is most likely produced by bacterial reduction of the sulphate which is present in considerable quantity in the water and would account for the black colour." A similar effect was seen on the land. If the dry red surface was scratched, the underlying damp soil was black. In the autumn the red turned to purple.

Effects on Animal Life

On the night of the flood, which was bright moonlight, the first thing noticed was a mass of dead worms being washed off the land. This complete destruction of earthworms is likely to be one of the most serious results of the flooding, not only to the many creatures which feed on them but to the soil itself, for they are of great value in keeping the land aerated and drained. Wire worms seem unaffected.

Hares and rabbits, utterly bewildered, were swimming or galloping (where they could find ground on which to gallop) in the hope of reaching a bank or an island. Very few survived and even those that reached a temporary place of safety, such as a bank just clear of water, gradually starved or died from lack of fresh water. Nearly all rats mice and moles were destroyed, but a few water rats which probably entered the area after the flood found a living on the young reed when there was no other green thing to eat. A few stoats escaped and there was no lack of corpses or of weakened survivors to provide them with a meal. When the meal was finished the stoats left. Most of the otters seem to have moved from the salted area, but from June onwards there was a certain amount of work visible on the otter runs.

Partridges and pheasants seemed particularly helpless for, of course, they were roosting at the moment of the disaster, and in this marshy area no pheasant ever thinks of roosting in a tree, but always in rush or sedge. The destruction of both pheasants and partridges was nearly complete, for although a number of pheasants reached banks and bushes that showed in the middle of the inland sea, they seemed quite unable or unwilling to attempt a flight across the water long enough to reach a place of permanent safety. Many eked out a miserable existence for a time on banks just clear of the flood, but there was neither food nor fresh water and the numerous corpses showed that practically all these perished, the only survivors being the few which reached a dry area sufficiently large to provide a permanent supply of food.

The complete destruction of rats and mice naturally caused the departure of the kestrels, brown, barn, longeared, and shorteared owls. Little owls can still find a living on the Horsey oasis. Sparrow hawks remained and nested in dead woods, but as soon as the young could fly the entire family left the district.

During February large quantities of wigeon rested on the flood waters and a certain number of other duck remained for a time in the district, but no shoveller or teal came in to breed and nearly all the mallard left. The flood had a strange effect on one mallard duck. My keeper, while investigating a wood that had been under sea water, noticed something

odd about an old sparrow hawk's nest, whose occupants had been photographed in 1936. He climbed up the Scotch fir to investigate and found a freshly-hatched clutch of mallard's eggs in the sparrow hawk's nest. No doubt the ducklings negotiated safely the twenty feet drop out of the nest into the sea water, but it is very unlikely that the ducklings survived, for there can have been none of the insects present on which they normally feed. Not a single brood of young duck was seen the whole season. No doubt owing to the death of the worms there were no snipe on the flooded area, but a number of redshank found good living for a time on the shallows;

There was an unusual influx of golden plover in February which fed on the arable land by the edge of the floods, and the shallow sea pools attracted for a time passing waders, such as ruffs and reeves, spotted shank, dunlin and others, but they all left when the pools were drained.

About 120 acres at Horsey remained an island of green in an inland sea, and, when the water was drained off, an oasis in a red brown waste. This oasis harboured more or less its normal bird population, but even here death, probably from drinking sea water or from starvation, was constantly occurring in the Spring. A green woodpecker was found dead by the side of a salt dyke. A pair of spotted woodpeckers that had excavated a nesting hole suddenly disappeared. A kestrel weakened daily until it could no longer fly and sat disconsolately on a pasture until it died, and a barn owl's corpse was found in the garden. For some time this area, where alone the trees remained healthy, was short of its normal company of wood pigeons and stock doves, but these gradually increased during the Spring, and turtle doves seemed quite unaffected, for they were as plentiful as ever. Apparently the dove family can drink salt water. Some of the warblers, such as willow wrens, which gave the island a passing look, soon left it, probably owing to lack of insects, but garden warblers remained, and on the whole the bird population in this small area was not radically changed.

But the island was the one bright spot. Elsewhere in the marshes there was a strange and deathly silence. For weeks after their normal times of arrival not a single sedge warbler or grasshopper warbler was seen in an area where in normal

times they are to be met with everywhere. No grasshopper warbler was heard the whole summer. Hardly any meadow pipits stayed and few were seen. Larks, however, in small numbers remained. A few reed buntings attempted to breed, but apparently without success. Cock cuckoos frequented the oasis, but there were no hens, and no cuckoos at all in their usual haunts in the marshes. There were no coots at all, and although water hens remained, no young ones whatever were seen. The great crested grebes failed to produce families.

About the beginning of May when the young green reed was shooting, a few sedge warblers appeared together with a large number of reed warblers. There were some cases of very late breeding. For instance on September 8th a young reed warbler was seen just out of the nest, and a pair of meadow pipits were feeding young on a salted marsh. The bearded tits which wintered in considerable numbers in the reed beds, wandered about trying to find food and nesting sites. They seemed eventually to concentrate, but only in small numbers in the neighbourhood of large reed beds which had not been cut, where they could extract grubs from the reed stems. Here they behaved as if it were still Winter, and for some time gave up any idea of nesting. The first nest containing eggs was found early in June, but it was soon deserted. None of them inhabited their normal nesting places. Nearly all the water rails, which were abundant in the Winter, disappeared, but a few pairs remained to breed in the flooded area and may have fed on spiders which survived in heaps of rubbish and possibly in the tallest sedge.

The effect on bitterns was peculiar. A few of them tried to brave out the strange conditions and no doubt found eels, which were not destroyed by the salt water, but for a long time they were quite incapable of producing a proper boom. They could manage the single grunt with which they open a normal season in February and March, but it was not until June that they regained their voices. Four boomers were heard on a still evening in the first week in June from Horsey Mere, which represents about a quarter of their normal numbers. One pair of bitterns, however, successfully reared two young, and are said to have discovered a small area in the parish of Waxham, where frogs were available. Out of two clutches of

marsh harriers' eggs, five in each nest, only one chick was hatched.

The main effect on the birds that stayed in the area during the summer seemed to be not merely inability to rear a family, but lack of desire to do so.

Conditions at Hickling were similar to those nearer the coast and I have permission to quote from Mr. Jim Vincent's article in "Country Life":—

"I have not the slightest evidence from the whole of the affected area that one single young mallard, shoveller, teal, coot, moor hen, water-rail, lapwing, redshank, snipe or great crested grebe has been reared, so complete has been the débâcle. This dearth of young bird life also affected the harriers. This is the first season for over forty-five years that I have not seen a montagu's harrier.

The flood has had very disastrous effect upon the water plants, and botanists will learn with regret that I am very apprehensive that it has wiped out *Naias marina*. Dykes that annually were ablaze with water violet (*Hottonia palustris*) also bladderwort (*Utricularia vulgaris*) are bare. The giant sow thistle (*Sonchus palustris*) survives. *Pyrola rotundifolia* is now only represented by a few plants.

The floor of Hickling Broad was mainly covered by the *Charas* and *Naias*. The sea water left this covered with a gelatinous skin of rubber-like solution which gripped the weeds like an adhesive plaster. When the warm days came and the gases became active, they caused this skin to be blown up and unroll like enormous sheets of parchment tearing all the weeds up by the roots. At present all these weeds are coated with this muck, and until such time as they can free themselves of it, no coots or diving ducks will feed on the ground, as it is all unpalatable to them.

Fresh-water fish by the tens of thousands had perished by March 20th. On May 15th the urge to come up and spawn from the rivers brought a number of roach and bream, but they perished in the attempt. Since then the fish have laid back in the rivers, and on all the affected Broads the water is far too saline for them to come up.

I can see millions of small shrimps from $\frac{1}{4}$ inch to $\frac{1}{2}$ inch long which many people take to be small fry. I see no possible chance of fish coming up before next year, and not until such time as fish can come up and live is there any hope of vegetation growing."

With the exception of eels, whose aptitude for changing from sea water to fresh and back again, served them in good stead, all fresh water fish were killed as soon as the salt water reached them—first at Horsey, later at Hickling. Numbers of them attempted to find safety by swimming in front of the sea water up narrow dykes, but there was no escape. None apparently survived. Their place was taken by creatures from the sea, which in their turn must also have perished or be doomed to death, except in cases where they have been washed down to the sea again after a twenty-mile trip to Yarmouth. One of the millmen secured a 2 lb. cod at Horsey mill and a grey mullet was caught at Hickling. A crab was seen to walk across a ploughed field into a dyke. Numbers of sprats and shrimps were caught at mills and in dykes, together with some smelts and a few herrings. The easiest place to catch the sprats was where a large hay stack that had been transported by the flood had come to rest against a dyke. When, during the final stages of the pumping, water was rushing down the dyke through a mass of hay, the sprats appeared to be choked in the obstruction and lay there dead or dying in the water.

Fresh water fish began to reappear at Potter Heigham at the end of May and spread slowly upstream, but not sufficiently slowly, for dead fish were seen from time to time. There were enormous numbers of shrimps in the dykes in the autumn and sea barnacles first noticed at the end of June were clustering in great quantities on flints timber and reed stems in Horsey Mere. This multitude of shrimps may have accounted for the remarkable invasion of spotted crakes in November. These birds frequented the hover on the edge of the mere in abnormal numbers and must have found abundant food, for they stayed some time.

The swallowtails and dragon flies which are such a feature of the marshes, were far more than decimated, but it is certain that some swallowtails hatched in the salted area. A fresh

cocoon was found on the side of a bank, and a certain number of the butterflies were seen during a period of S.E. wind, when it is practically certain that they could not have flown into the area off unsalted land. How they fared I do not know, for there was no ragged robin beloved of the insects and very little milk parsley for the caterpillars. I expected that all the milk parsley would be killed, but that was not the case, for a few small patches were found. It was evident that by September there were more insects, including dragonflies in the marshes. Swallows and martins in small numbers were hawking over them, where practically none were seen earlier in the year.

Effects on Vegetation

Of trees, Corsican pine seemed to possess the greatest resistance to salt water, and in places where water covered their stems for three months these trees looked fairly healthy, but all other conifers are pronounced to be dead and the Corsican showed no life by the Autumn. A group of young silver birch in Brayden marshes that stood in salt water seems healthy, although other birch in the neighbourhood appears to be dead. A few isolated oaks put forth a mass of green at an early date, and may survive, while others near them have shown no sign of leaf. Horse chestnuts in several cases put out foliage and flowers before the proper date and then withered as though it were a dying effort, as it probably was. Willows also seemed to make attempts early in the flood to show that they were alive, but subsequent shoots withered. Mr. C. H. Thomson, a timber expert, inspected the trees at Horsey in August and October. He found that all the conifers were dead, but that the deciduous trees particularly oak and alder showed some sign of life under the bark. He therefore recommended felling the conifers but leaving the deciduous trees at any rate until next Spring ; further, that no replanting should be attempted before the autumn of 1939 and then only if the salt content of the soil had been reduced to a more normal level. In the meantime that the dead undergrowth should be cleared and burnt. We received much information from Holland concerning the effects of sea water on timber and other vegetation. This is recorded later under the heading of a parallel from Holland.

Reed will no doubt survive, although its growth has been slow and patchy. It has reached an average height of two feet instead of five feet and contrary to the general rule, the best growth is along the dyke banks and on the higher portions of the marshes. The growth on the lows is very poor. Since its main competitor, common rush, is completely killed off, reed is likely to spread and cover a wider area.

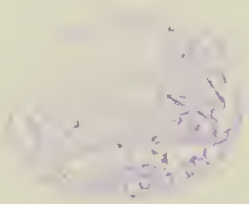
Giant sedge has been checked, but in most cases not killed, but the common sedge or cheat shows no sign of life. Lesser bulrush or gladden seems to have been entirely killed except in a few places, and even there its growth was very late and weak. This is likely to cause the floating hover, which is composed of this plant, to rot and break away from the edges of the broads and produce more open water*. The death of the lesser bulrush will be serious for the bearded tits for they obtain insects for their young from the heads of this plant. Pin rush (*Juncus maritimus*) in contrast to common rush has survived and is spreading. A sub-maritime rush (*Juncus gerardi*), was seen to be growing in a number of lows on the marshes as the water receded and flowered at the end of June, and twitch grass began to appear on marsh and stubble as the land dried, but has made slow headway. Great bindweed (*Calystegia sepium*) was not killed, but its growth was checked. Bramble, thorn, privet, laurel and rhododendron were all killed at once, even when their roots were only covered by sea water for a few hours. Clover in a field that was only washed over by the sea for one night, was killed, whereas the grass in the same field survived.

It was feared that that rare plant the marsh sow thistle (*Sonchus palustris*) which grows on the edge of some of the dykes in Brayden marshes, would have received too large a dose to survive. Some of the plants have in fact been destroyed, but by the end of June a number of new shoots were showing at the foot of the old withered stems, and these appeared healthy, although very slow in growth in the first week of July. These plants, although they only grew to two feet instead of four or five, were in full flower in the first week of September. There has been no sign whatever of the giant spearwort (*Ranunculus Lingua*) whose yellow flowers used to enliven the wall of reed on either bank of Waxham Cut, where it enters Horsey Mere.

*This has already happened; much of the hover disintegrated during high water in December and January, leaving open water up to fringe of reed growing on more solid material.

Salted Oak wood in September

Salted marsh with pin rush (*Juncus maritimus*)



FARMING ASPECTS OF THE FLOODS.

On March 19th, after the sea water had been on the land for just over a month, Mr. F. Raynes, Director of the Norfolk Agricultural Station wrote a letter to the "Eastern Daily Press" on the farming aspects of the floods, which I have obtained permission to quote. The effects he mentions will no doubt be felt by wild plants as well as by arable crops.

"The extent of the damage to the soil and the time likely to elapse before the land will again be cultivated is causing the County Agricultural Advisory Staff some concern, for we are now in a position to say a little about it.

The water has receded from one or two fields and analyses show that the percentage of salt in the soil is too high for arable crops to be grown profitably. But it is not the salt in itself that inhibits plant growth even when present in concentration, which will cause so much trouble—it is the after effects that will be serious. There have been sea inundations before, in Essex and more recently when the Humber overflowed its banks, and they are very familiar with the problem in Holland. In the case of the Humber overflow the land was flooded for no more than fourteen days, yet it was sufficient to kill off all arable crops that had been planted and to prevent full cropping for at least three years.

The cause of this catastrophic condition is the secondary action of the salt water in causing what is known scientifically as deflocculation of the clay, which then behaves as badly as it it possible to behave, holding water as effectively as a pond and defying all successful efforts at soil amelioration. Thus, the more the land is worked the worse will the position become, the greater will be the puddling effect on the clay, until flocculation can again be brought about.

After the inundation by the Humber, the addition of lime and calcium sulphate (gypsum) was tried, but while theoretically sound, their effect was not so good as leaving the land alone, permitting it to colonise again naturally, assisted by sowing grass and clover seeds as soon as they could be established.

A few farmers worked the land immediately after the water had been removed and were only rewarded for their misguided enterprise by a worsening of the condition; from five to seven

years is said to be the time the land was derelict in consequence.

Horsey arable land, therefore, seems likely to be out of effective cultivation for some time, although probably not quite so long as that around the Humber, for the soil is not quite so full of clay. Nevertheless the condition becomes more serious the longer the sea water is on the land; it has already been there for over a month, which is over twice as long as the instances upon which my argument by inference is based.

There is, of course, much more grass than arable land at Horsey, but grassland is by no means immune from the effects of salt water. "Where the land was under grass" write Page and Williams, who investigated the Humber inundation, "the damage done was not severe and in some instances a complete recovery had occurred in three years." There seems little doubt, therefore, that the landlords and farmers of Horsey are likely to grow little or nothing from the land for at least three years."

In fact the sea water lay on most of the land for two more months after this letter was written, that is six times as long as in the Essex and Humber floods.

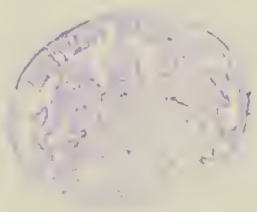
The Beginnings of Recovery

I was away from home from mid July until the beginning of September. Until I left there was little to ease the depression; signs of recovery were few and far between. Reed, watergrass (*Juncus Gerardi*) and pinrush (*Juncus maritimus*), provided the only break in the flat dead surface of the marshes, the only green in the series of reds and browns. Fat hen (*Chenopodium album*) was beginning to appear, as the forerunner of the goosefoot invasion, to which I shall have to refer in a moment.

When I returned in September, no doubt partly owing to prolonged absence, the change seemed considerable, depression ended and interest quickened. Things had happened and were destined to happen at an increasing rate. There was a growth of grass and other seedlings on the sides of the roads and elsewhere in places where rain water had washed out the salt. The white shiny surface due to the salt on the top

Barnacles. Horsey Mere

Orach (*Atriplex patula*) in a kitchen garden, spread 10 feet



of the land that had been such a feature under certain conditions in the summer was less marked, and has since disappeared. It will however probably return in the spring owing to increased evaporation.

Together with the two maritime rushes, watergrass and pinrush, the chief agent in the early reclothing of the salted area has undoubtedly been the goosefoot family (*Chenopodiaceæ*). Members of this family which includes the marine ancestor of sugar-beet, seem to be not merely resistant to salt, but to revel in it, and judging by the taste of their leaves which give them their English name, they suck up the salt. They have run riot and the future alone will prove whether their invasion in 1938 is going to be a blessing or a curse. At present I take the view that any growth, however obnoxious, is better than none; and that these saltlicking plants have at least helped to break up the surface soil.

When the first of these goosefoots, fat hen (*Chenopodium album*) began to appear in woods in June and soon after in the open, we were grateful for the relief of green in a world of browns. The next member of the family, glasswort, locally known as samphire (*Salicornia europœa*) which sprang up all over the salted marshes and arable in July, was alarming. Presumably it had come from seed washed away from the coast, some of it from the area of the breach, where it grew before the breach occurred on a patch of ground inland of the sandhills, where salt water leaked through. I do not like seaweed in my kitchen garden, even when it is supposed to be good to eat, and was glad to see it wither and die in September. We have learnt from Holland that it is unlikely to recur next summer. As the summer advanced and autumn began the various forms of orach (*Atriplex patula*) sprawled all over the place in uncouth cushions, and reared their fleshy stems to form a jungle, in particular near where high water mark had been. Orach was in fact the dominant plant of the marshes in the autumn and it took many forms. It is likely to be a pest for the next few years. By October we felt that we had had about enough of the Goosefoots and were thankful when they began to turn from green to red and brown and black.

Individual sugar beets appeared in strange situations throughout the late summer and autumn, on the sides of roads,

in salted woods, on banks, and in the middle of the marshes. Some of them were as well grown as the beet on land that had escaped the flood. These isolated plants must have come from seed off the beet tops left in the marshes as winter feed for cattle, which had floated about in the salt water. Moreover, when beet that had been sown near high water-mark line was being lifted in October, beet seedlings were still coming through among their larger brethren from seed that had lain dormant and only germinated when the salt content was sufficiently reduced in the particular portion of soil in which that seed had lain. It seems odd that sugar-beet should thrive on salt. Mangolds behaved in a similar manner under the same conditions.

Beet and mangold gave only one of many illustrations of the fact that seed was lying dormant all over the place awaiting the moment when it could germinate. This was constantly shown not only under natural conditions but under the series of experiments which were being conducted throughout the summer and autumn. I shall refer to these experiments later and must return to the various forms of wild vegetation which were peeping out in marsh, arable and woodland.

Silver-weed (*Potentilla anserina*) appeared in July and groundsel (*Senecio vulgaris*) soon followed. But the most conspicuous growth was the jungle that formed along the line of high water mark. By September this consisted of a matted tangle of orach, fat hen, thistle, sea rocket (*Cakile maritima*) with scattered plants of a spiky glaucous grass, grey-green in colour (*Elymus arenarius*). In the middle of this jungle were a few orange garden marigolds, but where they came from was a mystery. Lower down on the marshes particularly in the hollows where fresh water had run or lain, were lines and groups of various seedlings of all ages.

The weather at the end of September and beginning of October was favourable for washing out the salt for heavy rain was accompanied by long spells of high wind. While the rain washed the land, the wind kept the windmills constantly in motion pumping the salt water out of the dykes into the broads and rivers. The effect on vegetation was marked by mid October ; indeed this period showed far the greatest change. As the salt content of the surface soil diminished, growth

began not universally but in patches all over the place. In the woods a little ring of green appeared round the bases of the dead (or apparently dead) stems, where rain water had run down the trunks and washed the salt out of a small patch of ground. In the open, grass (at first mainly twitch grass) and other vegetation appeared. Maritime plants began to look unhappy either because of a shortage of salt or more probably because their appointed time to die had arrived, while other vegetation pushed out furtively to take their places.

Some rush marshes were burnt in mid October and when the fire had past and licked up the dead matted rush, the bare black face of the marsh was found to be covered by a minute growth of young grass. The marshes looked as if they had forgotten to shave for two or three days and had grown a tiny green beard. This was not the case everywhere. Some marshes, where drainage is particularly bad, remained damp and in many places covered with a film of shallow water. These produced no growth whatever, except along the slightly raised edges, where a little grass was showing.

As an instance of early recovery that subsequently failed, the corner of a pasture, which had only been covered by salt water for two or three days and showed signs of growth in May, was almost bare again in October. Cattle which had access to this pasture throughout the summer, since the rest of the field had escaped the flood, probably poached the surface and so prevented recovery. On the whole, however, October seemed an encouraging month, since it showed that all sorts of vegetation was only waiting for salt content to drop to a certain point. The moment that that point was reached, out it came.

The Mere in the Autumn

The Mere was perhaps the most depressing part of the affected area. Owing to the fact that concentrated salt water was constantly being pumped into it by the mills, the salt content diminished very slowly. The hover, consisting of gladden (lesser reed mace) showed practically no sign of life and was dull grey in colour instead of the gorgeous autumn yellow. No weed whatever was visible on the surface and it is doubtful whether the minute covering of weed on the bottom will make any growth for some time, even if there is any life left in

it. Not a single coot or diving duck was seen on the Mere in October, when normally coot, tufted duck, scaup and golden eye are fairly numerous. The first coots (only about fifteen in number instead of the normal, 100 to 200), appeared in November, but kept closely to a confined area, where probably a little weed existed on the bed of the mere. Even then it was rare to see a diving duck, whereas normally there should have been large numbers.* Since the flood not a single swan has been seen on Horsey Mere, but by November swans had returned to Martham Broad—another proof that fresh water springs had made its water fresher than elsewhere in the area. In the autumn teal seemed to object to salt much less than mallard, for the former came in to feed on shallow water in considerable quantities, whereas mallard were never in large numbers.

EXPERIMENTS

A number of experiments have been conducted throughout the summer and autumn on the salted land. Mr. S. K. North took the greatest pains in collecting the seeds of 250 species of wild plants, some of them supposed to be very resistant to salt. Six packets each containing the seeds of these 250 species were used in one of these experiments. The contents of five of the packets were sown in early July in various sites in the salted area, in a wood, on an open rush marsh, in heavy, medium, and light sandy soil. The sixth packet was sown as control in boxes containing good garden soil unaffected by the floods. This sixth packet produced a miniature variegated forest at once. Until October not a single seed in any of the five packets sown in the salted area produced anything visible to the most careful inspection. Healthy seedlings from the control packet sown in garden soil, were transplanted into the salted plots. Without exception they withered and died in a night. The results during the summer were absolutely and entirely negative. In mid October for the first time the watch on the patches containing Mr. North's seeds was rewarded. Several seedlings appeared, which were indentified by Mr. Ellis and are recorded in his observations.

Vegetable seeds which had all failed in the summer, now began to germinate in the autumn. Members of the cabbage

*Up to Feb. 20th, 1939 no diving duck have remained on Horsey Mere, and very few have even looked at it: there have however been some throughout the winter on Heigham Sounds and Hicking Broad together with coot.

family sweet peas and beans sown in September in a salted garden, which had been full of orach and samphire, germinated in mid October. Seed in an artificial hollow three inches deep germinated a fortnight earlier than the same variety of seed sown on the land where no hollow had been made a few inches away. Whether this was due to the presence of less salt at a depth of three inches or to water collecting in the hollow and washing out the salt, I cannot tell. It is too early to say whether these vegetable seedlings will survive.

We had hoped that the sea flood might allow us to make a fortune out of asparagus, which is supposed to like salt. So far the experiments with asparagus seed have produced one solitary seedling and the fortune looks a long way off. A Cox's Orange tree that had had a washing of salt round its roots, produced quite a good crop, while the gooseberries raspberries and black currants round it were all killed. According to information from Holland pear trees are more resistant than apples.

Mr. F. Hanley, the Advisory Chemist at Cambridge and Mr. J. C. Mann of the Norfolk Agricultural Station, have taken great interest in the scientific aspects of the flooding and the following is a brief resumé of their work.

" Nearly all of the flooded land was inundated for at least ten days, most of it for three months. There was nothing to be gained by taking soil samples from the whole of the flooded area until the salt concentration was reduced to a point where plant growth might become possible. Accordingly two typical fields were chosen from which soil samples, taken at intervals, have afforded an indication of the changes in salt concentration during the past months. Weather conditions obviously have an important effect on these changes, which no doubt would have been quite different if the season had not been unusually dry. The soil samples were drawn from the same portions of the fields each time, in an endeavour to avoid the wide fluctuations in salt concentration that are known to occur in different portions of even the same fields ; even so, there are still large variations within the small area sampled. In addition the salt concentration varies greatly at different depths and arbitary sampling depths were consequently taken.

The first samples taken at the end of February from land which had been flooded 7 to 10 days and clear for 7 to 4 days showed that the top 7 to 8 inches contained up to .3 per cent. salt while the sub-soil 8 to 16 inches varied from .07 to .2 per cent. salt. Samples taken at various depths at the end of March showed that there had been an increase in the salt in both the soil and sub-soil, the top 3 inches containing as much as .7 per cent. salt. By the end of June following the abnormally dry Spring the excessive salt concentration in the top soil became obvious from the patchy and white appearance on the surface where salt had crystallised. At this period the top 3 inches contained as much as 1.6 per cent. salt, but there was no great alteration in the percentage in the sub-soil. During August and September the percentage of salt in the top 3 inches fell until during the first week in October it was just below 1 per cent., again with little apparent change in the sub-soil. Following the rather wet September and October, the November sample indicated a diminution in salt concentration in the top soil, while the samples taken in December showed a further reduction, the top 3 inches containing approximately .2 per cent. salt at that time, with a corresponding increase in the lower layers, suggesting that the salt was being washed down into the soil. Unless drainage is efficient therefore, it is highly probable that some of this sub-soil salt will again find its way through the surface layers next summer, when soil evaporation becomes greater than rainfall precipitation. In any case the salt still remaining in the surface layers is well above the level at which Dr. Cranfield of the Midland Agricultural College suggests normal crop growth is possible, and the cropping of the flooded arable land in 1939 is thus extremely doubtful.

The removal of the salt is, however, only the first stage of the reclaiming process and while the salt is still present it hides the second problem, namely the deleterious action on soil texture resulting from salt water flooding. This will follow in due course and its effect will be accentuated by the very low lime reserves in the soils ; particularly on much of the grassland. In consequence lime dressings will be necessary over the flooded area and for this purpose the lime sludge from the local beet factory at Cantley is eminently suitable."

A Parallel from Holland

In November, I visited Holland with Mr. Bassett Hornor, and Mr. J. C. Mann of the Norfolk Agricultural Station. The Dutch authorities spared no pains to give us the information at their disposal and to put us into touch with those who have spent their lives in fighting the North sea and in restoring land that has been flooded.

We visited, among other places, the Anna Paulowna polder, which was flooded to a depth of about nine feet in January, 1916, owing to a breach 200 yards wide in the great sea wall, the sea water lying on the land for just over three months. This is a parallel case to Horsey with the following differences : in the Anna Paulowna polder the drainage system was, and is, of the highest order, the pumping stations extremely powerful, and owing to previous experiences the Dutch knew exactly what to do to restore the land. On the other hand the depth of their flood was much greater and the levels almost uniform, whereas in our flooded area there is more variation in level and also the Winterton Martham ridge, which bounds the flooded land, is constantly furnishing some fresh water from its springs.

In the winter the salt descends ; in the summer when evaporation increases it rises to the surface, so that we must expect next Spring to see once more the glistening white surface. The winter is the time in which to wash out the salt.

This is not the place to record the wealth of information with which we were supplied concerning the methods of recovering salted land. Suffice it to say that the system consists of washing out the salt with the help of deep quick drainage, of superficial cultivation, and avoidance of ploughing, which will merely exaggerate the damage done by the flooding to the texture of the soil. No cropping is attempted until soil analysis shows that the salt concentration in the soil is reduced to .3 per cent.* in the Spring.

This is the place to record what we learnt of the effect of sea flooding on wild vegetation. In regard to timber, the only tree that escaped destruction in the Anna Paulowna polder was a tamarisk. We actually saw it, but all the other trees had been planted subsequently to the flood, again only after analysis taken 28 inches deep had shown that salt concentration

*or 3.0 per thousand.

had diminished sufficiently for planting. From information available concerning this and another flood near Amsterdam it appears that some oaks may survive, young trees having a better chance than old. Common beech is distinctly resistant to salt, much more so than copper beech. Ash, alder, willow, horse chestnut, conifers, were all killed, horse chestnut as at Horsey putting out leaf and flowers during the actual flood, but never again. Poplar in some cases survived. Elm was more resistant but put out very few leaves for seven years. The only tree on which we failed to get information, was silver birch, because there was none in either of these flooded areas.

Coarse grasses covered the marshes at first, being gradually succeeded by more valuable varieties.

Reed resumed normal growth in the second year after the flood. Samphire (*Salicornia*) only flourished the first year, but orach (*Atriplex*) was a troublesome weed for some time. The Dutch laughed when I strewed their offices with samples of these revellers in salt, which I had brought to prove the seriousness of our case, but they were interested in sea rocket which they did not know. We gathered that it will take some time for weed to grow in salted dykes and broads, but I know that it must have returned in twenty years, for there were coots and pochard in a wide canal in Anna Paulowna polder.

Worms began to reappear in the third year after the flood in the Anna Paulowna polder, presumably from eggs. In a neighbouring area, the Weiringermeer polder, reclaimed from the sea in 1929 (now so valuable, that for fifty plots of 50 to 160 acres, let out on lease to farmers this year at a high rent, there were 1,100 applications) there are still no worms except in the gardens, where they have been introduced in the manure. Frogs in small numbers are said to have been seen in the second spring after the flood. We saw no signs of moles ; probably they would not be allowed.

Owing to the great difference in depth and efficiency of drainage between Holland and East Norfolk it seems probable that recovery will be slower than in Holland. On the other hand from the Martham Winterton ridge, fresh water will be continuously entering the southern end of the flooded area, and at the same time fresh water from the Palling Ingham-Lessingham area will be pumped into Waxham cut and help

to freshen Horsey Mere and to some extent Heigham Sounds and Hickling. Moreover, there is some slope on portions of our flooded area, whereas in Holland the levels are almost constant.

Conclusion

The visit to Holland to consult the Dutch authorities, who have an unrivalled experience in reclaiming salted land, has proved beyond all possible doubt that the pace of recovery will depend in the first place on the efficiency of the drainage, which is far inferior to the standard insisted on in Holland; unless it can be vastly improved—a costly proceeding—recovery is bound to be slow.

Secondly it will depend on the restitution of the soil texture, which has been damaged by the salt, the particles of calcium clay having been transformed into sodium clay.

The change back to calcium clay is brought about partly by the action of bacteria, carried down into the soil on the roots of plants, such as lucerne, trefoil, etc. Probably the last areas to recover will be the affected broads, the worst drained marshes, and the heaviest land.

Recovery of other forms of life will keep pace with the recovery of vegetation.

IV Detailed Observations By E. A. Ellis

1. Conditions prevailing in the Flood Area before Inundation

That part of Broadland traversed by the river Thurne has long been subject to infiltration by salt water from a subterranean source at Horsey and its character modified accordingly* (1) (2). The chloride content of the waters during the last few years has ranged from a maximum of about 10 parts per thousand in ditches at Horsey to 1 or less in Hickling Broad; the average salinity of Horsey Mere has been a little under 2. At times there was an influx of salt water in the Thurne from Yarmouth, via the Bure; thus on October 26th, 1936, the river at Potter Heigham Bridge contained 17 per thousand chloride on the flood tide, while normally there would

*References given at end of this paper.

be between 1 and 2. It is seen that the water courses of that area could be inhabited only by plants and animals able to withstand in the first place more than a faint trace of salt as a normal condition and occasionally quite high salinities. Thus the area supported a somewhat distinctive population. Hickling and Martham Broads were famed for their luxuriant and specifically numerous *Charophytes* (3) and as the habitat of some interesting *Naiadaceæ*, including *Naias marina* not found elsewhere in the British Isles. The smaller crustacean fauna was always in a state of flux and presented a rich field for observation by the ecologist (4, 5, 6, 7).

The sub-maritime fen pasture occurring between Horsey and Hickling was described by Miss Pallis nearly thirty years ago (8). It was characterised by dominant *Juncus effusus*, *Agrostis tenuis* and *Juncus maritimus*, with smaller societies of *Juncus gerardi*, *Phragmites communis* and *Eriophorum angustifolium* and the grasses *Holcus lanatus* and *Triodia decumbens* were abundant. In addition there were extensive tracts of small reed mace (*Typha angustifolia*) and giant sedge (*Cladium mariscus*) with other typical East Anglian fen plants.

Salinity in the marsh dykes was usually higher than in the high-level system of banked-up rivers and broads and supported such partly salt-tolerant plants as *Potamogeton pectinatus*, *Myriophyllum spicatum*, *Lemna* spp. and *Oenanthe fistulosa*, with occasional *Samolus valerandi* along the banks. The fauna included insects adapted to life in brackish water : larvæ of caddis flies (some *Limnophilids* live in 23.4 promille salinity in Norfolk), a number of water-beetles, some diptera (*Eristalis* spp., *Chironomids*, etc.) and water-boatmen. One of the molluscs present was *Paludestrina jenkinsi*, which can exist in waters varying from that of sea saltness (about 30 per thousand) to perfectly fresh, but occurs most commonly where the salinity is between 1 and 8. The writer found it in waters of 1.8 and 8.4 per thousand respectively at Horsey in 1929 and it was still thriving in the Mere and Martham Broad after the flood (breeding in water of 21.2 per thousand, June 26th, 1938).

It will be seen that the truly aquatic life of this district was better prepared for trial than that of higher ground reached by the flood, but even so it is feared that many of the interesting species in all zones succumbed to the exceptional conditions

thrust upon them so quickly. There are grounds for hope that seeds often survived while growing plants died and that the occasional island refuges provided by tree trunks, the higher tufts of sedge and reed and " hover " which broke loose and floated on the night of the flood, saved a remnant of the insect, spider and mollusc population. It has to be remembered, too, that surrounding districts (e.g. the Ant valley) in many cases supported outlying colonies of plants and animals similar to those swept by the flood waters, for instance : *Corophium lacustre*, an amphipod living in mud dwellings among the tubes of a brackish-water hydroid, *Cordylophora lacustris*, was recorded from Ant mouth and Ludham Bridge as well as from Potter Heigham and Heigham Sounds (9). G. I. Crawford (in litt., 1935) states that this *Corophium* occurs in " those reaches of sluggish rivers where the salinity ranges from a negligibly low quantity to about two-thirds that of the sea," so there is every chance it has survived somewhere in the neighbourhood.

2. Effects of the Flood on Plants and Invertebrates

The following notes record the status of various plants and animals so far as could be estimated in the year immediately following the flood. Mortality arising from the sudden influx of sea water was due to osmotic disturbances set up in living tissues, by changes brought about in the physical properties of the soil and in some cases by direct toxic effect.

The Flowering Plants

Species followed by (1) appear to have succumbed to the inundation ; (2) a few are known to have survived ; (3) appeared as seedlings, usually on peat or leaf-mould (i.e., not on clayey marsh soil) by June and mostly continued growth during the summer ; (4) came up as seedlings in the autumn after rains, especially in places where rain water had run along little gulleys ; (5) received a set-back but survived in appreciable numbers ; (6) salt-loving or known salt-tolerant species, some of which spread on to ground cleared of other vegetation by the flood. The term " promille " is used in places for " parts per thousand " chloride.

Ranunculus repens (2 and 3)
R. acris (1)
R. bulbosus (1)
R. flammula (1)
R. lingua (1)
R. trichophyllus (1)
R. heterophyllus (2)—known in 14 p.m. chloride.
R. circinatus (1)
Caltha palustris (2)
Castalia alba (1)
Nymphæa lutea (1)
Papaver rhœas (3)
Cochlearia anglica (6)
Sisymbrium officinale (3)
Brassica arvensis (3)
Capsella bursapastoris (3 and 4)
Coronopus procumbens (3)
Cardamine pratensis (1)
Cakile maritima (6)
Reseda luteola (3)
Viola canina (3)
Lychnis flosculi (2)
L. dioica (3)—seedlings in Floating Meadow Wood at Horsey were visible on June 26th and were flowering profusely there in October.
Stellaria media (3 and 4)
Spergula arvensis (3)
Spergularia media (6)
Malva sylvestris (3 and 4)
Geranium molle (3)
G. pusillum (3)
G. versicolor—the colony at Horsey Corner was not submerged.
Ilex aquifolium (1)
Aesculus hippocastanum (1)—mostly produced leaves and some flowered, but wilted and died in May.
Acer pseudoplatanus (1)—died after producing leaves and flowers.
Ulex europæus (1)—killed very quickly.
Medicago lupulina (3)
Trifolium pratense (1)
T. repens (1)—curiously enough, this was one of the first species to colonise the Lincolnshire "warplands" after salt flooding. (K. Blaxter, in litt.)
Lotus uliginosus (1)
Vicia cracca (1)
V. sepium (3)
V. sativa (3)
Lathyrus pratensis (1)
L. palustris (1)—formerly recorded from Hickling.
Prunus spinosa (1)—dead by May 5th, in some cases after flowering.
P. laurocerasus (1)—killed quickly.
Spiræa ulmaria (1)
Rubus fruticosus (1)—killed quickly; a few plants survived by reason of their growth on the tops of old hollow willow stumps, just above the flood-level.
Rosa canina (1)
Potentilla anserina (5 or 6)—flourishing under very salt conditions.
P. reptans (1)
P. erecta (1)
P. palustris (1)
Cratægus oxyacantha (1)
Hippuris vulgaris (1)
Myriophyllum spicatum (2)—previously a common plant of the Horsey dykes; has been found growing in water of 12.3 promille at Yarmouth.
M. verticillatum (1)
Callitriche stagnalis (1)
Lythrum salicaria (1)
Epilobium hirsutum (1)
Hydrocotyle vulgaris (5)—spread from raised peat down to flood level on Brayden marshes during the summer.
Apium graveolens (3)—found quite free from its common leaf-spot fungus *Septoria apii*.
Sium erectum (1)
Anthriscus sylvestris (1)
A. scandix (3 and 4)
Oenanthe lachenalii (6)
Oe. fistulosa (1)
Angelica sylvestris (2)
Peucedanum palustre (2)—grew formerly in every parish of the flood area.
Heracleum sphondylium (2 and 3).
Hedera helix (1)
Sambucus nigra (1)
Symphoricarpos racemosus (1)
Lonicera periclymenum (1)
Galium palustre (1)
G. aparine (1)
Asperula odorata—the colony at Horsey Corner was not submerged.
Valeriana officinalis (1)
V. dioica (1)
Eupatorium cannabinum (5)—some shoots a foot long were

found near the mouth of Waxham Cut on June 26th.
Pulicaria dysenterica (1)
Matricaria inodora (3 and 4)
M. suaveolens (3 and 4)
Artemisia vulgaris (2 and 3)
Tussilago farfara (2)
Senecio sylvaticus (3 and 4)
S. vulgaris (3 and 4)
Arctium lappa (2 and 3)
Cirsium lanceolatum (3)
C. arvense (2, 3 and 4)—killed only where long submerged.
C. palustre (?1)
Picris echioides (3)—one plant came up on previously cultivated ground at Horsey and flowered in the autumn; this species thrives near the sea in its few Norfolk localities; it grows within reach of the salt spray on Breydon north wall near Yarmouth.
Crepis capillaris (3)
Leontodon autumnalis (3)
Taraxacum vulgare (2 and 3)
Sonchus palustris (5)—huge old rootstocks near Waxham Cut put forth shoots at the end of June (the longest measured on June 26th was 8 inches). The plants flowered in September.
S. arvensis (3)
S. asper (3)
S. oleraceus (3 and 4)
Pyrola rotundifolia (2)—J. Vincent, at Hickling.
Rhododendron ponticum (1)—killed quickly.
Hottonia palustris (1)
Lysimachia vulgaris (1)
Glaux maritima (6)—locally abundant on marshes near the sea; some plants with white flowers near Crinkle Hill; flowers visited by humble bees, *Bombus terrestris*, July 7th.
Anagallis arvensis (3 and 4)
Samolus valerandi (6)
Fraxinus excelsior (2)—mostly killed; others were slow in leafing, but apparently a few survived.
Vinca minor (1)
V. major survived salt-water flooding which occurred on the same date at St. Olave's, Suffolk.
Centaurium umbellatum (1)
Menyanthes trifoliata (2)
Myosotis palustris (1)
Calystegia sepium (5)—late appearing but in abundance, especially among reeds surrounding the Mere.
Convolvulus arvensis (4)
Solanum dulcamara (2 and 3)
Lycium chinense (2)
Atropa belladonna (a)—remains of old plants found dead on the wa l of Horsey Mere, but no seedlings appeared.
**Digitalis purpurea* not observed (see correspondence between Robert Rising and Hampden Glasspoole on p. 381).
Rhinanthus cristagalli (1)
Utricularia vulgaris (1)
U. major ? (1)—once recorded from a dyke at Martham, by A. Bennett.
Mentha aquatica (1)
Lycopus europæus (1)
Prunella vulgaris (1)
Lamium purpureum (3 and 4)
Plantago coronopus (2 and 3)
P. maritima (6)
P. lanceolata (3)
P. major (2 and 3)—survived where not submerged longer than a month.
Chenopodium rubrum (3)
C. album (3 and 4)
Atriplex littoralis (3 and 6)
A. patula (3, 4 and 6)—this orach grew over many acres of ground swept by the flood and attained great proportions indicative of optimum conditions. It exhibited much variation; most of the plants were procumbent or slightly adpressed to the ground, forming circular mats commonly 7 feet across and one measured 10 feet; the upright bushy type was usually not so luxuriant, but ran to a height of 3 feet with a diameter of 5 feet; several specimens of the var. *bracteata* Westerlund were seen (determined by A. J. Wilmott). After seeding, the plants died in October and November. Stock doves, wood pigeons partridges and pheasants fed on the seeds in December (A. Buxton).
A. hastata (3 and 6)

Salicornia europæa (3 and 6)—upright and procumbent forms appeared over a considerable part of the marshes and arable that had been flooded ; the plants may have sprung from seeds derived from the stunted examples which grew behind the sand-hills at Horsey Gap.

Suæda maritima (3 and 6)—not common ; apparently introduced from further up the coast, the seeds having been sea-borne and stranded along drift lines.

Polygonum convolvulus (3 and 4)

P. persicaria (3)

P. aviculare (3 and 4)—including some bearing white flowers in September.

Rumex hydrolapathum (1)

R. crispus (2 and 3)—including the form *trigranulatus*

Daphne laureola (1)—leaves all fallen by May 5th.

Buxus sempervirens (1)

Urtica dioica (3)—and surviving at margin where just touched by the flood.

U. urens (3 and 4)

Myrica gale (2)

Betula alba (2)—At the beginning of May birches seemed less adversely affected than other trees, many being then in full leaf ; by June 26th they were nearly all dead.

Alnus glutinosa (2)—Alders were mostly winter-bare in May ; a few showed green shoots through the summer.

Quercus robur (2)—Oaks were growing more on slightly raised ground than in the low marshes and were slow to exhibit the effects of flooding ; many put forth young leaves in April, but with a few curious exceptions they had succumbed by the end of June. Odd trees remained alive in the midst of dead ones ; possibly in such cases the roots may have been tapping a little fresh-water spring. On May 5th one tree at Somerton was heavily laden with new oak-apples, whereas at Horsey Hall they showed scarcely any ; the former was standing in a flooded carr, the latter were growing normally on land untouched by the salt water.

Salix alba (1)—Some of the willows along the Horsey–Somerton road and in the marshes sprouted catkins and a few leaves, but these were for the most part withered by the first week in May ; the few shoots showing green were infested by willow aphides (P. E. Rumbelow) and the twigs were encrusted with scale insects. By the end of June there did not appear to be one white willow living in the area. That this species dislikes more than a moderate trace of salt is seen on the Acle New Road where young trees have to be replaced frequently as the road enters a brackish zone near Breydon.

S. cinerea (2)—A very few survived in the Mere itself ; scarcely one in the marshes.

S. repens(2)

Ceratophyllum demersum (2)—Hornwort has been found living in the Waveney at St. Olaves, where the water is not seldom in the region of 15 promille chloride.

Elodea canadensis (1)

Hydrocharis morsus-ranæ (1)

Stratiotes aloides (1)

Iris pseudacorus (1)

Polygonatum multiflorum (1)

Scilla non-scripta (2)—Occasional were showing on May 5th in otherwise bare dead undergrowth of a flooded plantation.

Juncus maritimus (6)

J. conglomeratus (including *effusus*) (2)—except for a few clumps seen on Mere Farm marshes, June 26th, the common rush, previously a dominant plant of the marshes, was practically wiped out.

J. gerardi (6)

Typha latifolia (2)—One colony with plenty of green foliage was found in a dyke at Somerton, where it had survived the full force of the flood and long submergence, July 7th.

T. angustifolia (2)—a little survived in the extensive "reed-swamps."
Sparganium ramosum (1)
Lemna polyrhiza (1)
L. trisulca (2)—known from water of 16.2 promille chloride.
L. minor (2)—known from water of 16.2 promille chloride.
L. gibba (1)—known from 8.3 promille chloride.
Alisma plantago-aquatica (1)
Sagittaria sagittifolia (1)—previously common in slightly brackish dykes at Horsey as well as in the Mere and broads.
Triglochin maritimum (6)
T. palustre (2)
Potamogeton natans (1)
P. coloratus (1)
P. lucens (1)
P. decipiens (1)
P. prælongus (1)
P. perfoliatus (1)
P. crispus (1)
P. compressus (1)
P. obtusifolius (1)
P. freisii (2)—found still living at Hickling (A. J. Rudd).
P. trichoides (1)
P. interruptus, vas. *scoparius* (6)
P. pectinatus (2)
Zannichellia pedunculata (?1)
Naias marina (1)—(see J. Vincent's observations, p. 359).
Eleocharis palustris (1)
Scirpus maritimus (6)—Mostly non-flowering in 1938.
S. lacustris (1)
S. tabernæmontani (6)
Eriophorum angustifolium (2)
Schœnus nigricans (2)
Cladium mariscus (5)—The leaves were still for the most part green at the beginning of May; much browning of foliage took place as the summer progressed, but flowers were produced and actual mortality was only slight.
Carex pseudocyperus (1)
C. riparia (2)—An infinitesmal number of plants survived, compared with the luxuriant growth of this sedge before the flood; but a clump here and there flowered at the end of June.
C. acutiformis (1)
C. inflata (1)
C. lasiocarpa (1)
C. fulva (1)
C. flava (1)
C. œderi (1)
C. panicea (1)
C. gracilis (1)
C. goodenowii (1)
C. canescens (1)
C. vulpina (2)
C. paniculata (2)
C. paradoxa (1)
C. diandra (?1)
Phalaris arundinacea (1)
Anthoxanthum odoratum (1)
Alopecurus pratensis (1)
Phleum pratense (1)
Agrostis tenuis (2 and 4)—On June 26th a very few plants of this one-time dominant were found surviving feebly; seedlings appeared in abundance on the marsh levels in late October.
Calamagrostis canescens (1)—A dead patch was found near Waxham Cut at the entrance to Horsey Mere, June 26th.
Ammophila arenaria (6)—Fragments of plants from the dunes were carried inland by the sea and became established in places usually foreign to them; also a few seedlings came up amongst drift-line material.
Holcus lanatus (1)
Arrhenatherum elatius (1)—Many of the dead bulbous rootstocks were visible on the water-swept marshes after the flood had subsided.
Triodia decumbens (1)
Phragmites vulgaris (6)—Reeds were showing young shoots more especially in the dykes and Mere on May 5th, later also on raised ground. They were stunted, but thrived and flowered.
Cynosurus cristatus (1)
Dactylis glomerata (1)
Briza media (1)
Poa pratensis (1)
P. trivialis (1)
P. annua (4)
Glyceria aquatica (1)
Festuca elatior (1)
Bromus sterilis (1)
Lolium perenne (2)

Agropyron junceum (6)

A. repens (2)—Twitch grass here and there beside the Horsey–Somerton road was found heavily infected with teleutospores of wheat rust (*Puccinia graminis*) and other small patches at Ford's Farm with ergot (*Claviceps purpurea*) in October; in both cases the incidence of the fungus was abnormally high.

Hordeum murinum (1)

Elymus arenarius (6)—As with the marram, odd pieces of sea lyme-grass broke away and became established well back from the dunes, along drift lines.

Seeds Sown Experimentally

Seeds of 250 species of wild British and foreign plants were provided by Mr. S. Kennedy North for experimental sowing in various types of soil which had been flooded at Horsey. These were put in at the end of June, but although many were ordinarily salt-littoral species, none showed signs of germinating until after the autumn rains. By October 23rd only one plot (that on somewhat sandy soil at Crinkle Hill) bore seedlings of the sown species, mingled with others of local origin. These were analysed as follows:—(a) certainly from Mr. North's seeds—*Lychnis coronaria*, *Dianthus squarrosus*, *Althæa kurdica*, *Anthriscus cerefolium*, *Tragopogon villosus* and *Datura tatula*; (b) almost certainly so introduced—*Calendula officinalis*; (c) among species sown but represented also by seedlings of local origin on the surrounding land—*Malva sylvestris*; (d) species other than those sown—*Capsella bursa-pastoris*, *Brassica arvensis*, *Stellaria media*, *Senecio vulgaris*, *Polygonum convolvulus*, *Chenopodium album*, *Atriplex patula* and *Urtica urens*.

The Conifers

Pinus sylvestris (1)—Some of the Scots pines were dead by the first week in May and all had at least a "scorched" appearance by then; all were completely withered by the end of June.

P. pinaster (5)—Stone pines survived in Floating Meadow Wood, Horsey, until the end of the summer, but showed no sign of life in the autumn.

Larix decidua (1)—Larches were still alive and putting forth shoots in May, but died during the summer.

Taxus baccata (1)—Dead in slightly flooded plantation at Horsey by May 5th.

The Ferns

**Pteridium aquilinum* (1)—see note * below.

Dryopteris thelypteris (1)

D. filix mas (1)

D. aristata (1)

D. spinulosa (1)

D. cristata x spinulosa (1)

Osmunda regalis (1)—Before the flood there were a few royal ferns just behind the Horsey dunes, all somewhat stunted and probably remaining from a swamp-carr which had been gradually overwhelmed by the sandhills travelling inland.

Ophioglossum vulgatum (1)—Killed on fen at Hickling Broad.

NOTE.

*Rising–Glasspoole correspondence in 1868, relating to the appearance of bracken and foxglove after drainage work at Horsey.

Hampden Glasspoole, the botanist of Ormesby, Norfolk, wrote to Robert Rising of Horsey Hall as follows :—

". . . . When I spent that very pleasant day with you at Horsey last summer, you took me to a spot where some very fine *Digitalis* (foxglove) was growing . . . . would you be so kind as to inform me in what year you first observed it and what was growing on the land before . . . . ? Dr. Turner, who compiled his work on plants during the reign of Queen Mary and who is the first English writer that mentions this plant says ' There is an herbe that groweth very much in Englande and specially in Norfolke, about ye cony holes in sandy ground, and in divers woodes, which is called in English Foxe-glove . . . . it hath a longe stalke and in the toppe manye flowers hanginge doune like belles or thumbles.' This brought from Rising a curious account of changes in vegetation at Horsey following drainage work ; he replied ' . . . . It is out of my power to say in what year I first observed the plant growing in the place where we found it, but it is full 40 to 45 years back. My first recollection of the spot is that of a bog with occasional knots of sedge growing about it and as a favourite resort of wildfowl, but inasmuch as cattle were continually sticking fast therein and had to be pulled out and were not infrequently lost, to prevent the recurrence of such mishaps, a deep drain, in the height of summer, was cut inclosing the same, and many remains of old trees (alders, oaks, etc.) and vegetable matter were thrown out. After this the inclosed spot was again crossed by similar drains, the material thrown out into beds . . . . The whole was then planted with oziers, sallows and willows, but nothing grew, tho' the same process was repeated again and again, until an opening was made from one of the drains to allow the bad water to flow freely from the place and very soon after this plants began to grow, first next the drains and at last throughout the beds generally there came up a variety of weeds and amongst others the Brake in great abundance and luxuriance and then came the Foxglove. Till then the brake was unknown to the present generation in Horsey and the old inhabitants had no idea what it could be. I presume therefore from these and other facts that we had the soil which, previously prolific, had been submerged by some extraordinary process of nature, and that so soon as the light and cleansing had renewed its fertility, the seed therebefore dormant therein sprung forth . . . .' The ' bad ' water referred to seems to have been *salt* water (E.A.E.)."

The Horsetails

Equisetum arvense (1)

E. palustre (1)

E. limosum (1)

The Mosses

The following mosses were found dead in places reached by salt water near Horsey Mere ; in some cases the same species were unharmed on banks and tree-trunks standing above the flood's peak level.

Dicranoweisia cirrhata, *Aulacomnium androgynum*, *Bryum capillare*, *Leucodon sciuroides*, *Brachythecium albicans*, *B. rutabulum*, *B. purum*, *Eurhynchium prælongum* and *Hylocomium squarrosum*. These were determined by Mr. A. Mayfield. *Fontinalis antipyretica* used to grow in Horsey Mere and Martham Broad but appears to have been destroyed.

The Lichens

The following lichens were killed on willow trunks along the Horsey-Somerton road, but only where they had been submerged (the water rose 2-ft. 6-ins. up many of the trunks). *Parmelia physodes*, *P. saxatilis*, *P. fuliginosa lætevirens*, *Xanthoria parietina*, *Physcia hispida*, *P. grisea*, *Ramalina farinacea*, *R. fastigiata*, *Cladonia fimbriata*, *Buellia canescens* and *Lecidea parasema*. These were determined by Mr. S. A. Manning.

The Fungi

The flood must have been disastrous to countless agarics in the marshes and alder carrs. *Bolbitius fragilis* came up among debris in a patch of orach and goosefoot at Ford's Farm, October 23rd ; on the same date a group of *Psilocybe ammophila* was found in similar tide-line stuff and Mr. Crees sent me the same species which appeared in several places in December. *Trametes rubescens* was seen on dead sallow boughs near the Gap.

Of plant rusts, *Puccinia epilobii-tetragoni* disappeared with its host ; *P. malvacearum*, universal on the mallows, was not present on *M. sylvestris* coming up after the flood ; *P. cirsii-lanceolati* and *P. obtegens* were absent from the thistles on which they usually abound ; *P. sonchi* was common on *S. oleraceus* and *S. asper* ; *P. menthæ* disappeared with the water-mint ; æcidia of *P. caricis* were found on nettles at Horsey Corner in June ; uredo–and teleuto–spores of *P. graminis* were rife on *Agropyron repens* in October ; *P. phragmitis*, previously common in the district as evidenced by old

teleutospores on past years' dead leaves of reed, became scarce although the alternating host plants (*Rumex* spp.) were not altogether destroyed—I found a few teleuto-sori of 1938 growth at Horsey in October; similarly, *P. magnusiana* used to be plentiful on the reeds but none was found living in 1938; *P. poarum* was absent from coltsfoot; *Uromyces polygoni* was abundant on *P. aviculare* in October; *U. rumicis* on a few docks by the Horsey–Somerton road; *U. scirpi* produced æcidia on *Glaux maritima* (including the form with white flowers) in June; old teleutospores of *Phragmidium violaceum* were found on dead bramble leaves; *Melampsora* spp. disappeared with the willows; *Coleosporium senecionis* produced uredo-and teleuto-spores on *S. vulgaris* and *S. sylvaticus* in the autumn (early stages are on pine); *C. sonchi* was abundant on *S. arvensis*, *S. asper* and *S. oleraceus* in October. None of the smut-fungi were seen. *Cystopus candidus* (crucifer blight) was present on *Coronopus procumbens* and *Capsella bursa-pastoris* in October.

Hyphomycetes found living included *Ovularia senecionis* on groundsel, *Torula graminis* on twitch grass, *Coniosporium sphærospermum* on reed, *Ramularia geranii* on dove's-foot cranesbill and an abundance of *Dematium hispidulum* on wheat straw from the bottom of a stack carried away by the flood. The Cœlomycete *Cytospora salicis* developed plentifully on the twigs of dead willows in the autumn. The ergots of *Claviceps purpurea* thickly infested *Agropyron repens* near Ford's Farm. *Xylaria hypoxylon* was seen in a cleft willow trunk that had been washed by the salt water; *Erysiphe cichoriacearum* produced perithecia on broad-leaved plantain and *E. polygoni* on knotgrass in October. While we were hunting for remains of insects, snail shells, seeds, etc. in debris surrounding Horsey Mere on May 5th, Mr. Crees picked up a dead ichneumon which was attacked by a fungus, *Hymenostilbe sphecophila* (Ditm.) Petch (determined by Mr. T. Petch), previously unknown in Norfolk.

The Bacteria

The widespread destruction of the original soil bacteria in the flood district will make re-colonisation of the land by rooting plants a slower process; as soon as conditions become

favourable again, however, the bacteria, by reason of their easy dispersal, are bound to return in a very short time.

The Algæ

No investigation of the phytoplankton has been carried out since the flood, but it should offer a very interesting field for research. Of the filamentous freshwater algæ previously common in the dykes, none were to be seen through the spring and early summer except the felt of *Cladophora glomerata* and a few traces of *Rhizoclonium hieroglyphicum*. The *Cladophora*, which has long been a nuisance in Heigham Sounds and Hickling Broad, has mostly survived the incursion of salt water and is at present abundant in Horsey Mere. Mr. A. J. Rudd found a little *Enteromorpha intestinalis* at Hickling in the autumn. The marshes had a smell of kelp when the waters subsided, though this could hardly be accounted for by the seaweeds swept inland.

The Stoneworts

No Charophytes were found living in their former strongholds of the Hickling-Horsey area; the following species used to occur: *Chara fragilis, C. connivens, C. aspera, C. polyacantha, C. contraria, C. hispida, C. vulgaris, C. canescens, Lychnothamnus stelliger* and *Tolypella prolifera*. The beds of rotting bottom vegetation floated away in great sheets as the summer progressed. *Chara vulgaris* at any rate will stand fairly high salinities and it is suggested that many of the above will be found to have survived as time goes on.

Invertebrate Animals

The Mollusca

Many thousands of freshwater mussels (*Anodonta cygnea*) were killed by the salts; when the animals decomposed the mussels floated for some time during warm weather in the spring. The same thing has been observed there in other years, on a smaller scale, when the salt-content of the water has been higher than usual. Shells of the following were found in flood rejectamenta at the margin of Horsey Mere, May 5th: *Theodoxus fluviatilis, Paludestrina jenkinsi* and its spined variety *carinata, Bithynia tentaculata, Phytia myosotis, Carychium minimum, Limnæa pereger, Planorbis planorbis,*

Succinea sp., *Vertigo pygmæa*, *Pupilla muscorum*, *Vallonia* sp., *Cochlicopa lubrica*, *Clausilia rugosa*, *Candidula caperata*, *Fruticicola hispida*, *Helicella nitidula*, *H. cellaria*, *Cepæa nemoralis* (forms yellow and red, each of three types : banding 00000, 00100 and 12345), *Helix aspersa* and *Vitrina pellucida*. Immersion in salt water had caused some corrosion of the shells. *Theodoxus fluviatilis* is known to frequent brackish water sometimes and has long been an inhabitant of Horsey Mere ; Holmes and Pryor (10) found it still living there in July, together with *Paludestrina jenkinsi* and what was much more surprising, *Bithynia tentaculata*. I have found *Limnæa pereger* living in water of 12 promille chloride and *Planorbis planorbis* in that of 9 promille, but in snail-analyses of many East Norfolk dykes *Bithynia tentaculata* usually disappears when the salinity reaches 4 promille.

A Freshwater Sponge

Ephydatia fluviatilis was established in a slightly brackish dyke by the road opposite Horsey Mill in 1929 ; it has now disappeared.

A Hydroid of faintly Brackish Water

Cordylophora lacustris used to be very common on submerged reed-stems, etc., in the Thurne district. It seems to like only slightly brackish water and is not exactly an estuarine animal. The very salt waters lingering in its haunts certainly checked its growth there ; no doubt it will become re-established in the area from outlying colonies in the Rivers Ant and Bure.

A Brackish-water Polyzoon

Holmes and Pryor found *Membranipora monostachys*, variety *fossularia* in Horsey Mere, July, 1938. This is most likely to be a newcomer, as it prefers fairly high estuarine salinities. It is common in dykes of 15 to 20 promille chloride near Great Yarmouth. Some years ago Mr. H. E. Hurrell found *Cristatella mucedo* living in Martham Broad, but doubtless this has been killed.

The Crustacea

The fresh and brackish-water crustacea of East Norfolk have been studied extensively by Dr. Robert Gurney (4, 5, 6, 7). The micro-crustacea of the Thurne system have always formed

a complex population fluctuating in character with the rise and fall of salinity. Unfortunately no-one has found time to collect the numerous samples necessary for estimating the changes brought about in the Copepod and Cladoceran fauna during 1938.

Following the flood, Dr. Gurney (in litt., 29.3.38) wrote "One would expect in Hickling that there would ensue a period with abundance of *Neomysis*." *Neomysis vulgaris* had been plentiful in that region about 1909, but had "completely disappeared" by 1929 (6). Low salinity can hardly have accounted for its obliteration, for this species can thrive in water as low as .8 promille chloride, e.g., in a dyke by the Acle New Road, in association with freshwater fauna and flora, 14.4.1933. However that may be, the Thurne and its broads teemed with *Neomysis* in the summer of 1938, as predicted.

The "Jack Shrimp" or white prawn, *Leander longirostris*, which ranged from the lower reaches of the river Bure to Heigham Sounds, going to sea to breed, was found only two centimetres in length at Martham Broad in August, 1938 (among material dredged by J. H. Capon). Large specimens of the sand shrimp, *Crangon vulgaris*, were taken at Potter Heigham (A. J. Rudd). *Corophium volutator* was found in Martham Broad and Horsey Mere; *C. lacustre*, formerly associated with *Cordylophora* in the Thurne (9) was not seen in 1938 (but see p. 375). *Gammarus zaddachi* became exceedingly abundant everywhere and fed upon all sorts of dead and decaying matter in the water, including dead freshwater fishes. The Isopod *Sphæroma serratum* appeared in several places, including Hickling Broad and Horsey Mere; specimens examined were all rather small (about 7 by 4 mm.), superficially resembling *S. rugicauda*, but their uropod exopodites were serrated, distinguishing them from this species (11).

The brackish-water barnacle, *Balanus improvisus*, quickly colonised the flooded Mere and broads. The nauplius larvæ were present in Horsey Mere in mid-February (10), and by the end of May millions of tiny barnacles had settled down on flints, reed stems, etc., in fact anything that would give them firm anchorage. As the summer progressed they became very noticeable and were seen to be present throughout the area, although most plentiful at Horsey, and attained maturity

about the end of July ; nauplii were found by Holmes and Pryor on August 2nd. Many of the barnacles died and dropped from the reed stems in late autumn and it is probable that great havoc was wrought among them by the frost in December, when Horsey Mere was frozen. This species has long been present in the lower reaches of east Norfolk rivers ; Gurney recorded it from the River Bure at Muckfleet more than thirty years ago (4, 5). In the drought summer of 1921, when tidal "salts" penetrated farther up-river than usual, this barnacle colonised the Waveney up to Burgh St. Peter, Oulton Dyke and the Bure as far as Acle ; it was present at South Walsham Broad in 1935, when the water was almost fresh (circa 1.0 promille chloride).

Shore-crabs (*Carcinus mænas*) were swept in by the sea but appear to have died out rather quickly, not being able to withstand low salinities for any long period ; I have found that they perish if left in dykes of even 16.0 promille chloride in the Yarmouth district.

Of terrestrial crustacea, *Philoscia muscorum* was still living among flood refuse at the margin of Horsey Mere on May 5th ; *Armadillidium vulgare* was alive on slightly raised ground, but dead specimens of this and of *Oniscus asellus* were found in the debris.

Mites and Spiders

Innumerable *Hydracarina* were destroyed. Many of the marsh spiders were hibernating in old reed-tops, bushes, etc., when the inundation took place and so survived. Some of the ground Lycosids, e.g., *Pardosa amentata* must have floated and got safely stranded, for they were quite numerous in the dead marshes during the summer. The water spider *Argyroneta aquatica* was found living in strongly salt water among *Cladophora* at Horsey on June 26th ; I have found it in water of as much as 23.0 promille chloride in ditches near Great Yarmouth.

The Insects

The grasshoppers *Chorthippus bicolor* and *Tetrix bipunctatus* were frequent on marshes and banks near Horsey Mere during the summer.

The district used to be a good one for dragonflies, but few

were seen in 1938. In the following list of species formerly living in the Hickling-Horsey area, those marked " N " have also been found as nymphs among *Cladophora glomerata* in a cut running into Meadow Dyke at Horsey, a little north of Blackfleet Broad, by E. T. Daniels (March 1935 and 1936) :— *Brachytron pratense* (common, N., one believed seen flying over Horsey Mere, 26.6.38), *Aeshna juncea* (rather rare, Hickling), *Ae. grandis* (fairly common, ?N.), *Ae. mixta* (a migrant and probably bred in small numbers), *Ae. isosceles* (rare, bred at Catfield and Hickling and not found elsewhere in Britain), *Cordulia aenia* (rare, Hickling), *Orthetrum cancellatum* (locally numerous, Hickling and Horsey ; common about the mouth of Waxham cut, E.T.D.), *Libellula quadrimaculata* (common, N.), *L. depressa* (rather rare, Hickling and Horsey), *L. fulva* (locally numerous : rare elsewhere in Britain), *Sympetrum striolatum* (common ; seen at Horsey, though possibly migratory, in the autumn of 1938), *S. sanguineum* (Horsey, 1937, E. T. Daniels), *Agrion splendens* (recorded from Potter Heigham by F. Balfour Browne, 12), *Lestes sponsa* (fairly common), *Pyrrhosoma nymphula* (common, N.), *Ischnura elegans* (very common throughout the area, N. ; often breeds in brackish water, e.g., in 6.0 promille chloride near Great Yarmouth), *Enallagma cyathigerum* (common), *Cœnagrion puella* (fairly common), *C. pulchellum* (common, ?N. ; a few small blue-bodied dragonflies believed to have been this species were flying at Horsey during the summer), *Erythromma naias* (locally common, N.). See also Attlee's notes on dragonflies at Hickling in 1937 (13).

The aquatic Hemiptera mostly disappeared from the district after the flood, although some—e.g., *Corixa* spp. are known to tolerate brackish water. *Naucoris cimicoides* was found dead in Horsey Mere on May 5th. I remember finding numbers of *Notonecta glauca* swimming in the sea off Gorleston some years ago ; it would be strange if these water-boatmen had been killed off by the flood and I suspect that some will be found in the Horsey district when this group is studied there more carefully next year.

The coccids *Chionaspis salicis* were abundant on the dying willows in 1938 and the large willow aphides, *Lachnus viminalis* attacked the few shoots put forth in the spring.

Caddis flies formerly inhabiting the flood area included the following (C. Morley M.S. in part)—those marked with an asterisk are among the numerous Trichoptera known to breed in salt water in the Gulf of Finland (14) :—**Agrypnia pagetana*, *Grammotaulius nitidus*, **Limnophilus marmoratus* (occurs in water of 8.3 promille chloride at Great Yarmouth), **L. affinis*, *L. auricula*, *L. luridus*, *Leptocerus aterrimus*, **Molanna angustata*, *Holocentropus stagnalis* and **Cyrnus flavidus*. Many Limnophilids are able to withstand high salinities, e.g. *L. griseus* breeds in 23.4 promille at Great Yarmouth. The Finnish species listed by Silfvenius were in water sufficiently salt to maintain a growth of wrack (*Fucus*).

The flood was disastrous to Lepidoptera. Some of the wainscot moths pupating in stems of reed and reed-mace survived, but great numbers of buried pupæ perished. Larvæ of the nutmeg moth, *Melanchra trifolii* were found in great abundance feeding on *Atriplex patula* (q.v.) during the summer. The swallowtail, *Papilio machaon*, received a severe setback, but a few were flying at Horsey at the end of June, and a chrysalis was found by Mr. Crees. The fritillaries, *Argynnis aglaia* and *A. selene* survived in the sandhills, although they were less numerous than in 1937 (independent observations by C. J. Brooks, T. S. N. Hardinge and P. E. Rumbelow).

Of beetles, *Donacea cinerea* larvæ and pupæ were found on reed roots in Horsey Mere by Holmes and Pryor in July ; *Odacantha melanura* was living in flood refuse beside the Mere May 5th and *Coccidula scutellata* was taken at the same place on June 26th. Dead remains of *Hydroporus planus*, *Dytiscus marginalis*, *Cassida rubiginosa* and *Polydrosus cervinus* were found in flood rejectamenta, May 5th. None of the usual carrion or burying beetles were discovered in carcases of rabbits drowned in the flood.

Humble-bees, *Bombus terrestris*, most probably from nests on the " island " of Horsey Hall, were visiting flowers of Glaux maritima on the marshes in July. Among Diptera, the *Tipulids* suffered heavily in the marsh pastures and few " daddy-long-legs " were seen in the autumn of 1938 ; galls of *Lipara lucens* were found on a few of the reeds, but in nothing like their usual numbers. I found eggs of *Chironomus* sp. in material taken from Horsey Mere by J. H. Capon in August,

possibly the same species which breeds in water of over 16.0 promille chloride in dykes near Great Yarmouth.

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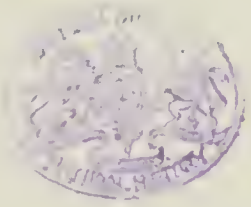


Photo] [*J.A.S.*

The Breach cut in the dunes near The Well in Norton Hills

Photo] [*J.A.S.*

The Bare Patch, Hut Marsh

V

SCOLT HEAD.

1. Report for 1938 by J. A. Steers.

The most important event of this year was undoubtedly the great storm and tide of February 12th. This was the storm that did so much damage at Horsey. At Scolt the damage was insignificant compared with that at Horsey, but nevertheless it produced some interesting changes. The Ternery dunes were considerably foreshortened and, as can better be seen from the map, changed a good deal in appearance. The survey mark which stood near the seaward side of the dunes was washed away and is now some 15–20 yards outside the dunes on the open beach. It may certainly have rolled a little way, but as it was a heavy cement block it probably did not go far, and Mr. Chestney thinks it has remained roughly in its previous position. The beach between the Ternery and the Far Point was washed over, and has altered a good deal. One patch of dunes at the Far Point remained in place. Once again the Sandwich Terns are nesting there.

The whole seaward side of the island suffered some erosion. A small breach was made (see map) northward of Spiral Marsh, but this was of no great import. Smuggler's Gap suffered far worse. Several small gaps were made in the western part, but the main breach was made at the eastern end. This is some seventy-five yards wide, and allowed the piling up of a great fan of shingle at the north-eastern corner of Hut Marsh. Waves probably lapped over all but the higher dunes in the gap at the height of the storm. A few smaller breaches or " almost-breaches " were made farther east, but are not of any real significance except that at the well in Norton Hills where the sea swept through the outer line of dunes and inundated the low in which the well was situated (see plate 9). The well was obliterated (now partly re-excavated and marked), and the drift-lines remain to show the severity of the attack. Some of the water driven into this hollow flowed through the dunes on to the marshes, but fortunately no severe gap was made. To anyone who knows the island well the cutting away

of the dunes all along Low Hills will be apparent. In places waves obviously washed right over them, and a belt at least some five or six yards wide has disappeared on their seaward side. It would only need a storm of considerably less severity than that of 12th February to cut a breach in this part of the island.

The long shingle ridge at the southern end of the Long Hills was swept over along its whole length, and pushed perceptibly farther on to the marsh.

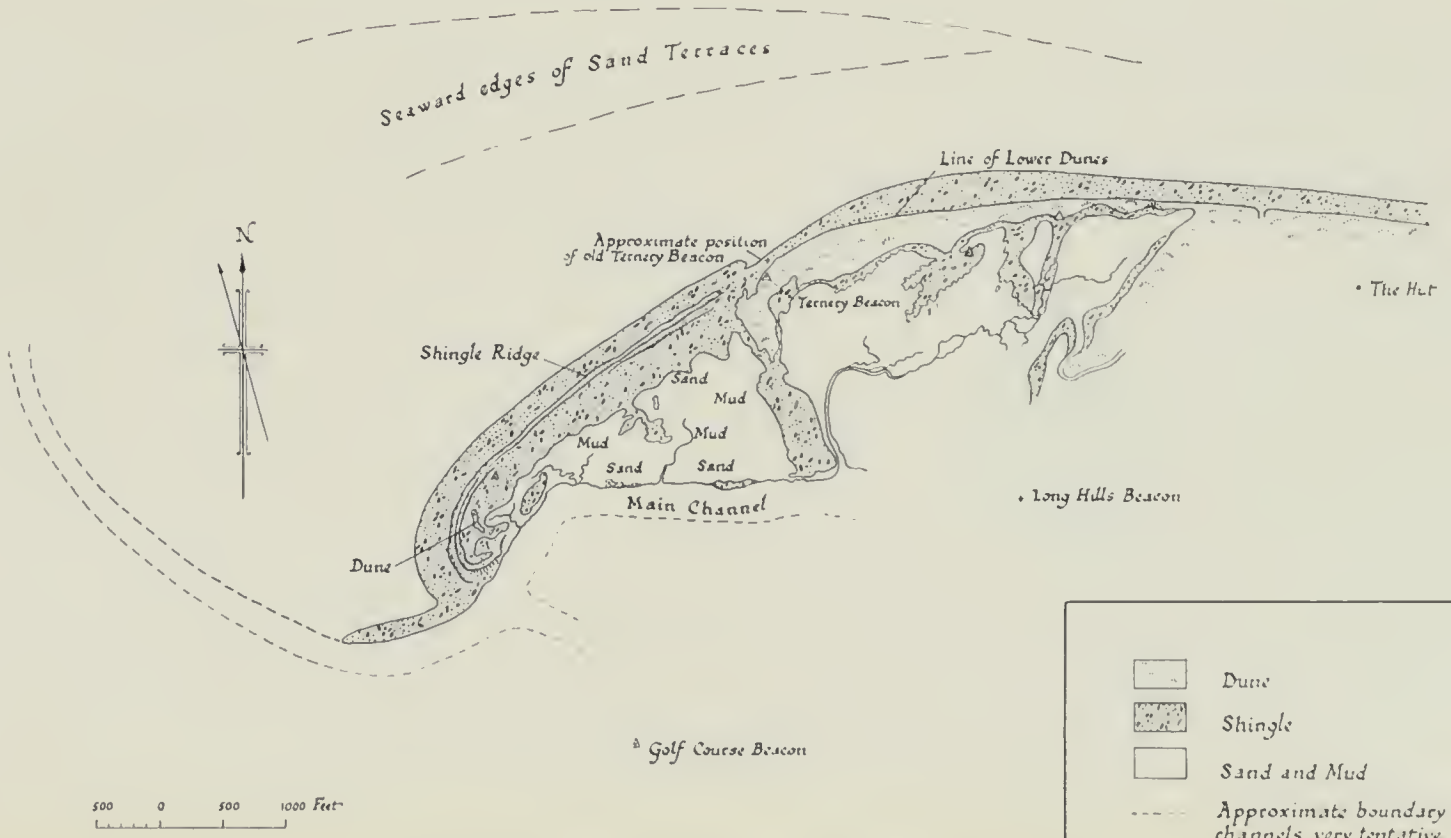
The tide was not expected to be a particularly high one (26-ft. 1-in. on the Hull Tide Table used for Scolt), but it coincided with a strong north-westerly gale. If the tide had been a high spring the damage would have been far worse. The Golf Links also suffered considerably. The slow but continuous growth of the Far Point and the pushing of the main Brancaster Channel nearer the Golf Course helped considerably in this. As long as this process continues the Golf Course is almost bound to suffer. During the storm of 12th February, the Club House was completely isolated and the sea broke into the reclaimed marshes immediately west of it. But from that point as far as Thornham no great damage appears to have been done. The Middle Island of Thornham, which had already become a mere shingle bank last year, is now still lower and stands only two or three feet above the general level of the sand-and-shingle flat on which it rests. All traces of vegetation have gone.

Visitors to Scolt will, however, be able for some time to come to form some idea of the storm because high drift-marks are left everywhere.

Along the inner side of the dunes on Hut Marsh a low but distinct " beach " is developing. This has been noticeable for some years, but seems to be rather more striking this year. The higher spring tides gradually wash a certain amount of sand away from the dune foot, and this accumulates as a low shelf in front. *Statice reticulata*, which grows so prolifically just below the Hut has colonised this beach, and is apparently extending eastwards along it. It meets the *Obione* of the marsh in a well-marked line along the outer edge of the " beach." A few years ago this stretch at the foot of the dunes was composed mainly of bare sand.

THE TERNERY AND FAR POINT.

JUNE 1938.



Surveyed June - July, 1938, by C. A. Fisher & R. H. Hughes

Of wider interest, but partly connected with the " beach " described in the previous paragraph, is the creek development on Hut Marsh. The bare patch (see plate 9) which was described in " Scolt Head Island " (1934) is still diminishing, but on the unvegetated parts of its surface *true* creeks do not exist. On its lower (i.e., southern) side, the normal creeks of Hut Marsh are gradually cutting back headwards in a way similar to that described for Missel Marsh in last year's report. Their gradual headward encroachment allows the vegetation to extend along them. On the northern side of the bare patch (i.e., on and near the " beach " described above) small creeks are very obvious. They are usually bordered by *Obione portulacoides* which has helped to accumulate the sand washed out from the dunes. As individual patches of *Obione* extend laterally and upwards, the water draining away after high tides gradually becomes constricted into channels. These channels disappear when they reach the bare patch, but during a flood tide they can be seen to have a slight dune-ward slope near the bare patch. The water draining out from these has a tendency to follow fairly definite lines across the bare patch to the heads of the creeks cutting backwards on its southern side. These lines, however, are often so vague that in several cases no clear differentiation in level can be seen, but it is obvious that several upper and lower creeks have already joined up, and that others are in the process of doing so. Hence, we have here an interesting case of creek-development proceeding from two "ends" at once. Mr. S. Swallow's careful map on a scale of twenty-five yards to one inch illustrates the point clearly, especially if reference is made to the notes accompanying it. In much the same way the creeks across parts of Upper Missel Marsh have developed, but Hut Marsh affords far and away the best case to be seen on the island. It demonstrates effectively the danger of generalising too much about a particular phenomenon and also brings out well the value of detailed mapping. In a few years time the " creekless " part of the bare patch on Hut Marsh will have disappeared. Vegetation will spread along the creek banks, and lead to the gradual covering of the whole patch with plants.

In last year's Report four maps of the interesting island west of Thornham Harbour were reproduced. It is not

intended to publish a map this year, but it may be noted that the winter storms had no great effect on the island. As was only to be expected it was washed over in its lower parts, and consequently shows a slight landward retreat. The two ends have also grown forward a few yards. But the shallow water off Thornham must have protected the island. The more exposed position of the Ternery at Scolt is largely responsible for the damage there. In a later report it is hoped to reproduce more annual maps.

A large party of Section E (Geography) of the British Association, Cambridge Meeting, visited this island on 20.8.1938.

The caterpillars of the Burnet Moth have once again ravaged the *Senecio* on House Hills. On other parts of the island the attack is far less severe.

It may be worth while noticing that the Hull Tide Table which is used locally appears to have been somewhat misleading of late. The times of high and low water agree as well as in former years, but the height to which the tides run are often somewhat at variance. This was noticeable during my stay at the island (June 21st to July 5th), and was also commented on by Mr. Chestney. I cannot support this statement with actual measurements, but it would be interesting to have the views of regular visitors to the island on the matter.

A rough check survey along the outer line of the island dunes shows that since Mr. Peel mapped the island in 1932 the more salient points near Scolt Head and Norton Hills have been appreciably eroded. The whole outer side of the dunes also shows erosion, but the amount is greater at these two places.

II. Marsh Development in Norfolk

by V. J. Chapman, M.A., Ph.D., Botany School, Cambridge.

From 1935 to 1937 measurements of accretion rates were carried out by J. A. Steers on the marshes of Scolt Head Island. The results of these observations were published in the *Geological Magazine* for January, 1938, but no attempt was then made to estimate the rate of development of the marshes. From the data obtained, however, it is possible

CREEK DEVELOPMENT ON THE
BARE PATCH ON HUT MARSH
Surveyed July 1938, by S. Swallow

NOTES.

All the creeks on the southern side of the bare patch are cutting back rapidly at their heads. The pattern is shown characteristically in all cases, but most clearly at A and B. When the tide *in the creeks* has fallen below the general marsh level, the surplus water draining off the bare patch cascades in little water falls over each tiny " head." If, as is sometimes the case, a layer of some sandy material underlies the more coherent and muddy surface layer, the sand may be washed out, and a distinct overlap or " cave," several inches long, may be formed. It appears that the extension of this process leads to a slight general collapse of an area a few square yards in extent near the head of individual creeks. It is seen on the surface in the form of cracks which can generally be distinguished from the normal cracks of dried mud.

After flooding tides, when a large volume of water is flowing back into the creeks, the cutting is rapid—perhaps two or three inches in one tide.

3. The creeks on the northern side can be seen to become less well marked as they approach the bare patch (see dotted lines). Lower down the creek pattern disappears and the water drains over the bare patch as a thin layer, although, on the ground, it can be seen to keep, when the patch is nearly dry, to fairly definite lines. These are far too faint to map. It will be noticed, however, that the heads marked A and B are showing a slight tendency to approach the creeks A' A' and B' B'. Remapping in a year or more will probably show that the junction has been made.

The same tendency can be seen in other creeks to the east of these. Creek C has already cut back and " captured " a northern creek. Creek D is the major creek of the north-eastern part of Hut Marsh.

To avoid too much detail many salt-pans have been omitted from the map.

The small " beach " referred to in the text lies between the dunes and the southern edge of the *Statice reticulata* zone. Generally this beach is marked by a very slightly higher ridge near its outer line.

Roughly, it may be said that south of the *S. reticulata* boundary and north of the bare patch *O. portulacoides* is the dominant plant. It accumulates sand round it and by its lateral spreading seems mainly responsible for the formation of creeks. On the southern side of the bare patch *Salicornia spp.* and *Suæda maritima* are far more prolific. There is also much *Pelvetia* and *Bostrychia*. These soon give place to the normal plant covering of the central part of Hut Marsh.

to estimate approximately the rate of development and the age of the marshes. It is the purpose of the present note to indicate how this may be done and to compare the results with those from other marsh areas. It is not proposed to repeat the figures obtained by Steers since they can be obtained by reference to his paper.

On the Norfolk coast the prisere (Primary Succession) develops normally as follows :—

Zosteretum
↓
Salicornietum
↓
Asteretum
↓
Late Asteretum
↓
Limonietum ↓ *Armerietum* } General Salt Marsh.
↓
Plantaginetum
↓
Juncetum

In addition to the prisere there are a number of subseres, but it is not proposed to consider these in studying the normal development of the marsh because they do not materially affect the age at which maturity is reached. The vegetation at the different sites from which the accretion samples were taken has been considered together with the accretion rate as recorded by Steers. The results are expressed in Table I.

TABLE I.

Vegetation	No. of sites	Av. rate of accretion in 21 months	Av. rate of accretion per annum
Salicornietum ...	8	1.19 cms.	0.68 cms.
Asteretum	22	1.71 ,,	0.98 ,,
Late Asteretum ...	4	1.57 ,,	0.90 ,,
Limonietum ...	5	1.41 ,,	0.80 ,,
Armerietum ...	5	0.63 ,,	0.36 ,,
Plantaginetum ...	3	0.73 ,,	0.42 ,,

The marshes on Scolt Head Island have been levelled in many places and the levels reduced to an arbitrary datum—Island Zero Level. From this levelling survey it has been possible to ascertain the vertical ranges occupied by the different plant associations on the marshes. The rate of development of any one marsh can be considered as taking place in a number of phases with, on the whole, decreasing accretion rates as the marsh becomes higher and tidal flooding correspondingly less frequent. On this basis it is possible to calculate the number of years it should take a marsh to develop from the *Salicornietum* stage to the final *Juncetum* stage at which point the marsh may be considered as mature. Unfortunately conditions have so far prevented any accretion rates being obtained from the *Zosteretum*.

Phase 1. *Salicornietum*

Range −.90 ft. to +.40 ft. I.Z.L. =1.3 ft. =39.6 cms.

Accretion rate, 0.68 cms *per annum*.

Time required for the phase, 58.2 years.

Phase 2. *Asteretum*

Range +.40 ft. to +1.30 ft. I.Z.L. =0.9 ft. =27.4 cms.

Accretion rate, 0.98 cms *per annum*.

Time required for the phase, 28.0 years.

Phase 3. *Late Asteretum*

Range +1.3 ft. to 1.9 ft. I.Z.L. =0.6 ft. =18.3 cms.

Accretion rate, 0.90 cms *per annum*.

Time required for the phase, 20.3 years.

Phase 4. *Limonietum*

Range +1.9 ft. to 2.3 ft. I.Z.L. =0.4 ft. =12.2 cms.

Accretion Rate, 0.80 cms *per annum*.

Time required for the phase, 15.2 years.

Phase 5. *Armerietum*

Range +2.3 ft. to 2.9 ft. I.Z.L. =0.6 ft. =18.3 cms.

Accretion rate, 0.36 cms *per annum*.

Time required for the phase, 50.8 years.

Phase 6. *Plantaginetum*

Range +2.9 ft. to 3.30 ft. I.Z.L. =0.4 ft. =12.2 cms.

Accretion rate, 0.42 cms *per annum*.

Time required for the phase, 29.0 years.

Table II gives an estimate of the time taken for the development of the marshes to the conclusion of each phase.

TABLE II.

Phase	Max depth of silt* at conclusion of phase	Time required for the accumulation of depth of silt found at the conclusion of the phase
Salicornietum ...	1.3 feet	58.2 years
Asteretum ...	2.2 ,,	86.2 ,,
Late Asteretum ...	2.8 ,,	106.5 ,,
Limonietum ...	3.2 ,,	121.7 ,,
Armerietum ...	3.8 ,,	172.5 ,,
Plantaginetum ...	4.2 ,,	201.5 ,,

Therefore the total time required for a marsh to pass from the beginning of the *Salicornietum* to the *Juncetum* stage is approximately 200 years. In a previous paper Steers (*Geog. Journ.* 1935) has shown, from a study of old maps, that Holme marsh possibly reached maturity—i.e., colonisation by *Juncus maritimus*—in sixty years. The measurements analysed above were all obtained from "*open*" marshes, whereas Holme marsh is of the "*closed*" type, e.g., the mouth of the marsh is bounded by two shingle ridges very close together, and it is known that closed marshes develop far more rapidly than open marshes because the physiographical conditions favour a more rapid deposition of silt. N. Nielsen (*Kgl. Danske. Selskab. Biol. Meddel.* Vol. 12, 1935), using similar methods, has estimated that open marshes on the west coast of Jutland, in Denmark, develop to maturity in about 100 years. These figures, of course, can only be maintained so long as it is assumed that the coast line is stable. There is no evidence at present which suggests that the marshes on Scolt Head Island were formed on anything other than a stable coast.

The calculations above cannot pretend to great accuracy, nor indeed are they intended to do so. If the soil were peaty some allowance would have to be made for compression, but the silt of these marshes probably only settles to a very small degree. There is also no great accumulation of plant remains. Some error may be introduced by occasional sand deposition from neighbouring dune systems. It can, however, be maintained that calculations of this character do give a definite indication of the approximate rate of marsh growth and that they are comparable with figures obtained from other areas.

* These figures do not make allowance for any abnormal depressions in the ground where a greater depth of silt may be found.

VI

THE FLOWERS OF MAREOTIS: AN IMPRESSION.

BY F. W. OLIVER.

THE present sketch of the Maryut Flora appears to be the first attempt to record any consecutive impression of the floral pageant of the Libyan Desert. Botanical travellers have listed the plants, poets and painters have depicted occasional aspects, but no objective account of an elusive phenomenon has yet appeared—elusive because although the desert soil is at all times charged and ready with the essentials for a great display, in most seasons the flora develops imperfectly from failure on the part of the physical conditions to co-operate properly.

My first experience of a Maryut spring (1930) was more than favourable, a promise of what might be, and served to keep hopes alive through the seven lean years that followed. Not that these years were entirely barren, for even the partial successes of a robust and versatile flora can be impressive. During three of these lean years (1935-37), being resident in the district, there was fuller opportunity to make acquaintance with the plants, their sequences and possibilities. It was only in the spring of 1938 that everything combined to provide a display rarely seen, and, according to the older Bedouins, last equalled forty-one years previously. So far as I am concerned it exceeded anything I could have imagined; whilst such visitors as came amongst us were held spell-bound at the sight. Under these circumstances I have endeavoured to pen the present impressions—inadequate as they are. Mine was the usual dilemma: if left, something inevitably fades from the mind; whilst to "do it now" implies a certain lack of perspective.

In this coastal belt of the Libyan Desert when a congenial and rising warmth follows adequate winter rains the first green stippling of the bare ground rapidly gives place to a carpet of flowers which fills the previously barren landscape. This persists in its various phases for about four months (January–April), the colours changing like a slow motion kaleidoscope, whilst the fragrance distilled drifts on the desert air.

These plants have to complete their lives before the heat and drought of summer destroy them. There is no wild, disordered riot ; the flora unfolds as an ordered pageant, and as one species goes out of flowering it is replaced by its predestined successor.

Maryut.

The name Mareotis or Maryut is somewhat loosely applied to the coastal strip of the Libyan Desert stretching westward from Alexandria towards the Italian colony of Cyrenaica. For us it is co-extensive with Lake Mareotis and its westerly arm (now a dry lake bed) reaching about 50 miles west of Alexandria to the neighbourhood of El Ruweisat beyond Hammam. (See Map, p. 405).

In Greco-Roman times there were water connections with a branch of the Nile, with traffic of boats and extensive settlements and cultivation in the sections between the present towns of Amria and Hammam. This water continuity was interrupted by silting and the land also may have changed its level. For a discussion of such matters, Anthony de Cosson's *Mareotis*, 1935, should be consulted.

In both ancient and more recent times the fertility of the district depended largely on winter rains due to the Mediterranean influence. These rains vary in amount from year to year between the extremes of 3 or 4 inches and 10 inches, or more. Bumper, i.e. rainy years, are scarce. The Bedouin barley harvest of 1938, as stated, was last equalled forty-one years ago. Since 1930 the harvests have been poor, some disastrous. And yet, in olden days, 2,000 or more years ago, the Maryut was famous for its grape-vines, olives and cereals. The question is often debated, is the rainfall more capricious to-day than formerly? Has the climate changed for the worse in the sense that the mean yearly rainfall has significantly lessened ?

From the time of the Arab conquest (8th century, A.D.) and the entrance of nomad Bedouins with their herds and camels there would be a cessation of intensive cultivation with progressive destruction of the desert vegetation ; to this one school of thought would attribute some diminution of rainfall. Moreover, desert shrubs which require years to establish are taken for fuel and have to be sought to-day at increasing distances

from points of consumption. As however our showers are mainly drifted in by northerly winds from the Mediterranean, i.e. our rain-climate is formed outside our boundaries, the shrinkage of the local scrub could hardly be an important factor in a matter of deterioration.

In this connection it is worth remembering the great numbers of ancient cisterns for rain-water storage. They occur in the hills and are numbered by thousands; they were filled by means of low banks diverting the run-off. Had rainfall been dependable would the immense labour of constructing so many cisterns have been incurred?

And then there are the old vineyards ("Karams)," with horse-shoe shaped banks 10-12 ft. high enclosing areas 5 to 10 acres on the slopes of the desert to the south; these banks have their openings directed uphill. They served to collect run-off. In addition to this the banks had a streamline profile causing the prevalent north winds to pass overhead, thus improving the conditions of cultivation in another way.

From which considerations it must not be taken for granted that rainfall in the Maryut has seriously declined during the last 2,000 years. On the non-maritime parts of the Libyan Desert it is less easy to express an opinion.

Topography and Morphology of Habitats.

The layout of the land of the Maryut is important in delimiting the various types of plant habitat. Roughly these habitats correspond to successive zones parallel to the shore. Outside are the dunes, a mile or more across. These are formed of comminuted, waterworn shells, pure carbonate of lime. These have been worn to the form of "oolites," i.e., oval and rod-shaped particles (Fig. 1, p. 401). Washed on to the beach they are blown inland to form dunes.

Within the dune belt is the outer rock ridge of cemented oolite shell debris, reaching a height of 100 feet. Within this comes the lake bed—a long westerly tongue of Lake Mareotis, having a width of 1½ to 2 miles. Being separated from the lake itself by two transverse causeways, this tongue is dry, except that it is liable to winter flooding by rain. To the south the lake is delimited by an inner ridge generally resembling the outer. The distance between these two ridges

is about 2½ miles. Both ridges were much quarried in ancient times for building-stone.

The southern face of the inner ridge slopes down gently for 1½ to 2 miles to the desert railway line (which runs roughly parallel to the coast), to the south of which the ground gently rises into the desert at an inclination of about 1 : 50.

Fig. 1.

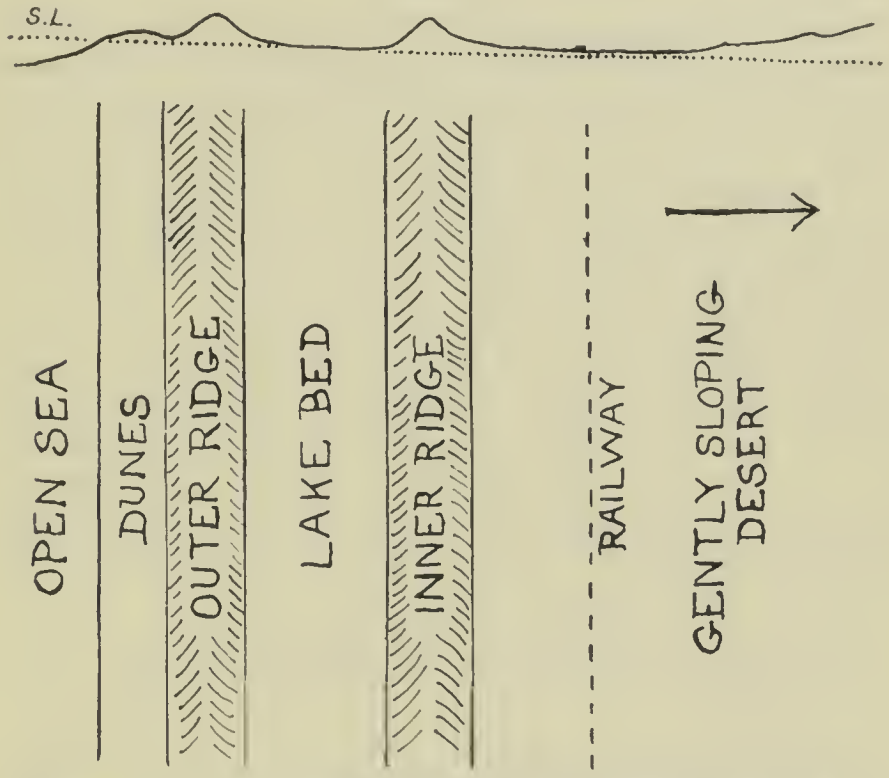


Diagram of typical coastal belt of Maryut extending ten miles inland, illustrating the successive plant habitats—
Above: profile; *s.l.*, sea level; *Below:* the zones in plan.

It is between the inner ridge and the desert, where the ground is nearly level, that the greater part of the barley cultivation is carried on. The width of the belt of cultivation varies from year to year according to the rainfall and the expectation of rainfall, and in any case hardly exceeds 15 miles from the coast anywhere. It may be explained that whilst one part of the barley is sown more or less to a date in autumn, another part is held back till the first reassuring showers have fallen. Beyond the limit given, rain does not fall in useful quantities, and the desert is more or less waterless (1 to 2 inches).

For a bird's-eye view of the whole Maryut a good point is an elevated summit on the outer ridge called Plinthine, one and a

half miles east of the temple at Abu Sir. As it gives a clear view over the inner ridge, which fringes the lake bed to the south, it dominates the whole landscape. The view is far more spectacular than the actual height (180 feet) would suggest, mainly from its extreme isolation; whilst the proximity of the sea with its iridescent colouring enhances the spectacular element (Fig. 2, p. 405).

Apart from the great inland headland, the Khasm el Eish, 25 miles to the west, the Maryut relief presents no outstanding feature ; it is a wind-swept country, streamlined from thousands of years exposure. But though the relief may be slight in actual measurement, it is never level, apart from the lake bed below and the floors of certain obscure valleys or wadis. Our landscape is the result of eternal forces (sun and wind) under which the soil is still in process of transport.

If the relief is gentle it is in no sense insignificant. Every slope and distant ridge has its meaning for the desert dweller, to whom currents of air are rendered visible by the dust they carry. The outspread landscape is a study in grey, beige and silver, and is singularly sensitive to effects of lighting, especially at dawn and sunset.

Habitats and Soils.

Seven principal habitats may be distinguished, viz. :—

1.—The dunes.

2.—The N. slope of the outer ridge.

3.—The South slope of the outer ridge.

4.—The Lake bed.

5.—The N. slope of the inner ridge.

6.—The South slope of the inner ridge, which gradually flattens out till it meets

7.—The Desert slope from the S.

Obviously these habitats have different aspects ; some are level, others have N. and S. exposures, respectively—(cf. Text fig. 1).

Soils.

But there is a further important diversity, that of the soils.

In desert regions surfaces become disintegrated through the sun's action and when dry these powdery surfaces are liable to removal by wind. Zones 1 and 7 are especially involved in this.

The dunes consist of minute shell fragments, and when the N. wind blows—and this is the prevalent wind—the shell sand tends to be drifted inland, especially on to zones 2 and 3. When the wind blows from the southerly quarter the finer particles of desert dust are raised in clouds which darken the heavens, and the condition of Khamsin prevails. These dust clouds drift seaward, so that desert soil is transported on to the other zones and superadded to their soils. Khamsin conditions are intermittent and may not operate on more than one or two days a month on the average, but the winds are violent and efficient. After a two-days Khamsin the dust brought into an ordinary house may be swept up in buckets full.

Thus, if we consider zone 3, the southern slope of the outer ridge, it is liable to receive accretions by wind transport from both the "oolite" dunes to the North and from the desert to the South, and since this has operated for thousands of years, the result is important, as its upper layers have been largely derived by this mingling of transported soils.

Actually the Khamsin fraction (desert dust) in zone 3 soils varies at different spots from 15 to 50 per cent. by weight of the whole, whilst the oolite fraction (derived from the dunes) shows a smaller average size of particle than is found on the dunes. This is probably due to friction in transport.

Analogous derivative (or migratory) soils are frequent in Norfolk, as at Blakeney Point and Scolt Head, where the marsh soils show interbedding of water-borne silt and wind-borne sand, derived from adjacent sand dunes. This blending by wind is important in respect of soil fertility, as will appear in the sequel. Thus we have two processes of erosion co-operating in the preparation of what is, definitely, a useful synthetic product.

Certain sectors of the Maryut (especially West of Hammam) being devoid of mobile coastal dunes, free oolite granules cannot be transported inland. This lack in certain cases seems to affect the fertility of the inland soils of these sectors unfavourably. In the absence of more complete data for the whole coast-line, it is not possible to say how far this suggestion is generally valid; it can only be settled by a future soil-survey.

Cultivation.

The various cultivations in the district—mostly by Bedouins —require some notice as they affect materially the magnitude of display of the wild flora. These extend from Alexandria to Hammam and beyond, and include the following :—

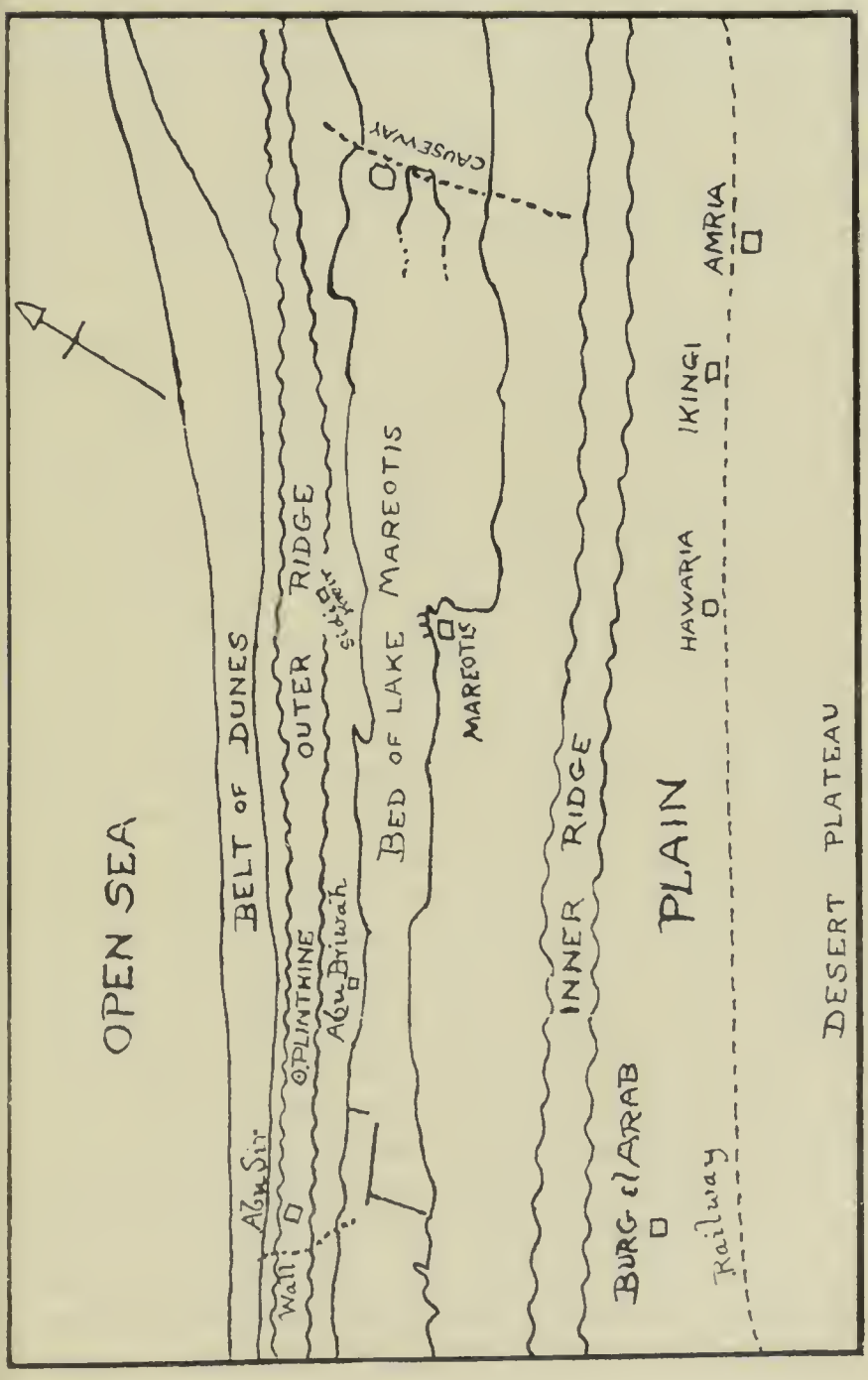
(1) On the lower slopes of the outer ridge (the Abu Sir ridge) and in certain sectors reaching up to the summit, including also the more stable parts of the dune fringe, are numerous fig-gardens, vineyards and plantations of date-palms with inter-culture of gourds, melons, tomatoes, cabbages, etc. Fig planting has increased greatly in recent years and is all but continuous from Abu Sir to the suburbs of Alexandria.

(2) The lands on the borders of the lake bed, both north and south sides, on the lower slopes of the inner (or Gebel Maryut) ridge, and on the broad flat zone to the south thereof, extending in favourable situations eight or ten miles into the desert ; these collectively form the main area of Bedouin barley fields—the staple cultivation. The procedure is simple and primitive. In the autumn the ground is ploughed to a slight depth by the traditional wooden ploughs drawn by such beasts as are available—donkeys, mules, oxen, camels. The seed is generally broadcast. The barley is not irrigated and depends on the winter rainfall. Here was a good harvest in 1930, and again this year, 1938. The seven intervening years were poor, or total failures. Nevertheless, the Bedouin are persistent and hopeful, since when seed cannot be saved there is assistance from Government and private sources.

On the average about 60 per cent. of the total possible barley ground is sown, so that by no means the whole lies fallow in alternate years. As the barley is generally pulled, not cut, little remains on the ground to plough in except the weeds. Normally the fields are bright with the wild flora, scarlet ranunculus, anemones, poppies, bulbous plants and other things. Without doubt the casual and inattentive methods of the Bedouins promote enormously the mass production of local flora, a fact which seems to justify them in offering for sale to passing motorists in springtime bunches of gay flowers. Some people, not realising this, deplore the practice lest it lead to extermination. But anyone who witnessed the marvellous display of wild flowers in 1938, a veritable resurrection, will

realise that there is no fear of this. Plant lovers really owe the Bedouins a debt of gratitude, and I think no reasonable person can blame them for trading their flowers. Were the Maryut cultivated according to rigorous methods, flowers would be found only in strips by the roadsides, on stony ground, on the salt marshes and uncultivated portions of the dunes.

Fig. 2



Sketch map of the region more particularly considered in the text, being the coastal belt of Maryut from Abu Sir to Amria. Scale (roughly) 1 :200,000.

The Flora

The Maryut flora, geographically considered, shows, as would be expected, a marked Mediterranean facies with which is blended a desert element. The number of species recorded for the Maryut coastal strip from Alexandria to Sollum (frontier of Cyrenaica) must considerably exceed five hundred, that is to say, about one-third of the whole Egyptian flora.

In average years our flora (excluding the salt marshes which have a later season) is in evidence for nearly five months, mid-December to mid-May. For the rest of the year the landscape reverts to white desert—a state less monotonous than might be supposed, as the desert surface, like the sea, is very sensitive to effects of lighting and atmosphere; so much so, that there is some risk of "desert charm" developing into a cult.

The visible beginning of plant life follows the first rainfall which is due in November. Green seedlings of sown crops commonly appear in January. The first glimpse of the barley is an outstanding event of the year. Individually the little green threads, perhaps half-an-inch high, are invisible, but collectively in their hundreds of thousands, seen against a low sun, the whole landscape is stippled with a vivid translucent green, though at midday with the sun near the zenith, you have to go on hands and knees to detect these little plants. This is a joyful day not only for the Bedouins, but also for their live-stock. The latter, the moment they recognise that "chlorophyll day" has come, get out of control and dash for the cultivated ground, so that the shepherd has to exercise forcible means of restraint. Though "chlorophyll day" from the nature of the case can occupy no fixed date in the calendar, it is the festival of all others which cheers the hearts of desert folk, as it confirms their faith. Even outsiders who inhabit the desert for their pleasure and not of necessity, are stirred in the same way. Beside it, "Harvest Thanksgiving" is more like a formal receipt for goods delivered.

Our rain comes to us in heavy showers from the Mediterranean, not as a rule persisting for more than a few hours at a time, but adequate for, say, half-an-inch. If this is repeated weekly for twelve weeks, that would be 6 inches of rain—sufficient for a modest display only. The winter of

1937–38, which produced crops of barley and flowers unequalled for forty-one years, had a rainfall of 10 inches, which began early and was continued at regular intervals (see table p. 423). Moreover, the temperatures remained cool (max. 75° to 80° F.) throughout the growing season, with only unimportant occasional warmer spells. On the other hand the thermometer rarely fell below 45° F. at night and never to freezing point. The first rains were in October and by the end of the month the ground was everywhere green—two months earlier than usual. Otherwise the weather was fine and sunny, but additional showers came just when required and the plants were never held at a standstill.

In the following sketch of floral sequence it is the zones other than the dunes and lake bed (salt marsh) that are especially referred to. In the main these zones carry the same flora though variously developed, and in varying abundance and combination, in different localities—as in all floras.

The dunes and lake bed have distinct and specialized floras and will be dealt with separately.

The general flora, which is flowering from Christmas to the end of April or later, shows, roughly, three phases, viz., the *Early*, *Middle* and *Late*. Naturally these overlap.

Early Phase

The first conspicuous plant showing everywhere and often in flower by Christmas is a perennial aroid, *Arisarum vulgare*, having a striped brown and green spathe with inflected point. It carpets densely ground now or formerly cultivated (barley fields, old quarry floors). This Herald of Spring, by its persistence, is a noisome weed, and should the Bedouins ever turn their minds to the cleaning of their fields, Arisarum ought to be the first to claim attention.

Another plant early to flower and continuing for many months is *Globularia arabica*. It grows everywhere in the crannies of outcropping slabs on the ridges, and on the desert to the south. A dwarf wiry shrub of alpine habit, it covers itself with small dense blue flowering heads.

Peculiarly early and quickly through its flowering is *Colchicum Ritchii*, a delicate rose-coloured "autumn crocus." Essentially a dune plant, it spreads on to the northern (coastal) ridge

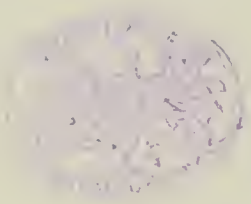
wherever the oolite granules have been carried by the wind. Each corm produces about ten flowers in succession.

But the outstanding plant of this phase is *Anemone Coronaria*. You may find it open at Christmas and continuing perhaps for ten weeks. It is essentially a plant of the barley fields where it grows gregariously in large patches or "pools," extending to many acres. The flowering scapes stand a foot above the still quite low barley which serves as a green background of lawn. A usual density would be eighty to a hundred flowering peduncles to the square yard at any given time. These patches are like pools and the heads are always swaying in the wind. Our strains of *Anemone Coronaria* are delicately tinted and not bright red, as in Palestine. For beauty of form, poise, surface, with delicacy and distinction of colouring, the Maryut has no plant to compare with it. As the scapes detach readily from the rhizomes, to which the leaves are separately attached, it lends itself to gathering in bunches without injuring the next year's display.

Commonly this Anemone occurs in two principal strains, usually confined to distinct "pools," though where pools overlap in their spread, the strains will be mixed. This spreading is vegetative and is doubtless assisted by the plough. One strain is pale rose-coloured with floral segments abruptly truncate after the manner of a Darwin tulip, the other pale grey to blue, the segments here being more pointed. The anemones have an advantage in flowering at a time when there is little to obscure or compete with their matchless purity. Even such Leguminosæ as are already showing lie prostrate on the ground, and the anemone-pools are visible from afar. But they are by no means everywhere; pools may be half-a-mile apart, and in some lines of country still less frequent—a restraint in distribution which adds to the pleasure of discovering them. As regards quality, it may be said generally that the best barley fields produce the best anemones.

Two principal strains have been mentioned, but in detail there are minor variants so that where one is familiar with the ground, it is often quite possible to recognise the source, if not of a single blossom, at any rate of a bunch. The commercial strains of St. Brigid anemones (and perhaps others) are stated to have been derived by breeders from *A. Coronaria*. If so,

Abu Briwah : Mid-March
Matthiola, Carrichtera, Chrysanthemum and Poppies



Description of Plate 12.

Plate 12. Carpet of flowers on the N. slope of outer ridge at Abu Briwah, two miles E. of Abu Sir. The distant high point (left centre) is Plinthine. The foreground is shared mainly by *Matthiola humilis*, *Carrichtera annua*, *Chrysanthemum coronarium* (in front toward right-hand side) and crimson *Papaver Rhœas* dotted everywhere. The plant like a wire entanglement (centre foreground) is a species of Brassica. Numerous other species described at pp. 410, 411, 412 to the number of perhaps one hundred are scattered everywhere. In middle distance are small fig-trees (not yet in leaf), whilst the region beyond, though no less floriferous, being more level, is foreshortened so that the flowers do not show. It is this back region where the various Boraginaceæ occur in such numbers (cf. p. 414). The zone of dark spots at edge of escarpment, especially on right, is *Asphodelus microcarpa*. The escarpment itself carries numerous plants in flower between the stones.—March 15th, 1938.

these strains have been bred for bright colours mainly. They have lost the essential beauty of the Maryut strain and become relatively gross.

Besides these Anemones of the fields, there are others also referable to the rather polymorphic species *A. Coronaria*. They are dwarfs a few inches high and grow in certain moist situations near rocks. These habitats are secluded from the ordinary wayfarer and are known to few. Still, if you know the habitats they frequent, such colonies are not infrequent. These dwarfs, which come into flower in their exposed habitats some weeks after the field forms open, are much more variable than the latter—both in form of flower and in colouring. In colour they range from pure white through cream to pale rose and so to the deeper crimsons, and in another direction through pale blue to mauve-like colours. They do not grow in isolated communities, or pools, but mingled together.

In form, too, the segments are variable—pointed, blunt, and sometimes with a feathered margin. All I know of their fixity is that specimens transplanted to the garden have remained dwarf for two years and produce flowers in their original shades. As to what happens when raised from seed, I have no experience. This dwarf race of Anemones is perhaps the most exquisite product of the Maryut.

Middle Phase

(*Illustrated on Plates* 12 *and* 13)

Long before the Anemones are done with the second or middle phase of the flora will be in display. This really forms the backbone of the whole, and in good seasons like 1929–30 and 1937–38 fills the landscape for hundreds of square miles. Fallow ground and waste differ only in degree from the cultivation, but the most spectacular effects are to be found where the surface has been recently disturbed.

Were farming "clean" these vivid pictures would be rare, and one visualizes a possible remote future, when the Maryut will have been fully reclaimed, when, if flowers are to be found at all it will be in special nurseries or sanctuaries reserved for the purpose.

Of the important families the Leguminosæ may be mentioned first, as they are very numerous (eighty species), are met with

everywhere, and must be of inestimable service as upholders of soil fertility in a land where manures are unknown.

In habit these legumes are largely trailers and thus liable to be screened by taller plants. Everywhere visible however, is *Trigonella maritima*, prostrate in habit, covered with umbels of little yellow scented flowers, and so characteristic that the Maryut would seem all wrong without it. Five or six other species are also present.

The Lotuses (Bird's Foot Trefoils) play a similar role and several are orange coloured. The nine species include *L. creticus*, *L. corniculatus*, the silvery-leaved *L. polyphyllos*, and *L. edulis*, whose succulent pods the Bedouins eat, the gesture of an epicure.

Medicago, Trifolium, Melilotus, Vicia and Lathyrus are represented by numerous species, as is Astragalus (Milk Vetch). Of the eleven many are beautiful, whilst *A. Forskalii* and *trigonus* are spiny shrubs.

Three species of Hippocrepis (Horse-shoe Vetch) with their oddly coiled and cusped pods, trail everywhere, as does *Onobrychis Crista-galli* (a kind of sainfoin) with its flat spiny fruits. An interesting and frequent plant is Scorpiurus, with yard-long trailers and coiled pods; finally *Lathyrus Aphaca* (yellow vetchling) with large paired stipules and a tendril between, whose modest primrose flowers have a distinction of their own. Other leguminous genera belong to the dunes and will be referred to later.

Cruciferæ (with fifty species) are important, especially scenically. They are everywhere and make a universal background. Constitutionally they are tough and flourish in spite of everything—like the cabbage tribe in a garden.

First is the mauve sea stock *Matthiola humilis*, diffusing scent everywhere and occupying more ground than any other plant in the Maryut. It grows indifferently in the cultivation, fallow, and on hard caked ground, biding its time to push its seedlings through the concrete-like veneer. In some places, e.g., the south slopes below Abu Sir, it forms belts a kilometer long and 100 yards wide, visible from afar. It thus takes a major share in the colour display, whilst indirectly, as mauve flowers do, it sets off its yellow, white and crimson companions to great advantage.

Another vital Crucifer on which much depends scenically, is *Carrichtera annua*. Its pictorial function is to introduce sheets of white into the landscape. When it appears, sometime in February, it is in almost pure formation, showing its crowded racemes of white flowers, at first only a few inches above the ground. Its effect is precisely that of a low belt of white mist such as might be expected in the early morning. These sheets often occupy kilometer-wide stretches, especially on level fallow; and even to-day, although thoroughly familiar with this effect, I find myself occasionally walking into this "ground mist" just to make sure I'm not being tricked by mirage. This curious quality appears to depend on the matness of the white surface of the petals combined with the fact that, especially in the earlier stages, the tips of the racemes preserve a dead level. Even with increasing age, as the racemes telescope out and the plant reaches a height of perhaps a foot, the effect of mistiness is never quite lost. As a specimen plant Carrichtera is nothing. Hardly anyone would include it in a bouquet; but from afar it is luminous, mysterious and unique.

One more Crucifer, a component of most formations, deserves mention for the luxuriant growth it shows under the most inhospitable conditions. This is *Enarthrocarpus*, a coarse growing prostrate plant smothering itself in trusses of (for a Crucifer) rather large pale lemon-coloured flowers streaked with deep violet veining. They are beautiful in the hand.

Among others there is the delicate, graceful (both in flower and fruit) *Biscutella Columnæ*.

Of *Ranunculaceæ*, the Anemones have been mentioned. Another conspicuous plant is *Ranunculus asiaticus* whose large crimson flowers are almost indistinguishable in colour from our poppies. This occurs especially in and about the cultivation, about mid-season. Locally there is an orange strain, whilst on rare occasions white flowers may be seen.

Adonis microcarpa (Pheasant's Eye) is locally abundant in the barley, especially in the fields below the Abu Sir ridge on the south side, where it grows rankly in damper places. A scarlet form is occasionally seen. *Nigella Tauberti* (Love-in-the-Mist) and *Delphinium nanum* (Larkspur) also occur as field weeds.

Bulbs.— A feature of the middle phase is the great number of bulbous plants. Early to appear is the yellow-flowered *Gagea fibrosa* (Yellow Star of Bethlehem) with its tuft of flowers sessile at ground level—on cultivation, fallow, and where soil is present on rocky ridges. A little later is the white-flowered Star of Bethlehem, *Ornithogalum tenuifolium*. This is frequent in the cultivation and reaches maximum density on fallow ground, where two hundred plants to the square yard is quite usual. The effect is not unlike that of a white, glossy linen counterpane, spread on the ground.

Of the Onion tribe (Allium) there are twelve species, rose-coloured, white and cream. They are sparsely scattered, not more than one or two to the square yard. The flower heads stand well above the neighbouring herbage.

Of *Muscari* (Grape Hyacinth) there are six species, blue, purple or wine-coloured and often very abundant. Then there are several Hyacinths and the showy *Scilla peruviana*—a broad-leaved rosette with numerous scapes of deep blue flowers. A coveted treasure in a garden.

In the greatest abundance is *Asphodelus microcarpus* with tall panicles (to 5 feet) of pale shell-pink flowers. It occurs everywhere, especially in land out of cultivation, waste land, and on the borders of the fields. The cultivation is relatively free of it as the plough throws up its tufts of tuberous roots which tend to dry out in the sun. In some waste areas it forms an almost continuous jungle for miles.

A common plant especially of oolite soils is a handsome large-sized Aroid *Helicophyllum crassipes* whose spathes gape open showing a deep black lining.

Lastly, of the bulbous sort, is the dwarf *Iris Sisyrinchium* which, though rather local, is met with in the cultivation, and also on the salt marshes in large stands, where a density of a hundred to the square yard is often reached. Its colour ranges between pale lavender, rose and pale blue. The structure of an Iris flower is such that its colouring is displayed by a multitude of surfaces at many angles, so that properly to appreciate their quality, Sisyrinchium flowers should be viewed from the direction of the sun, against the sun, and across the sun. This really applies to flowers in general ; they should be viewed from a moving platform rather than from a fixed point.

This should be some consolation to such motorists as may be disinclined to leave their cars ! To prevent disappointment, it may be mentioned that Sisyrinchiums open their flowers in the afternoon only. Their season is generally the latter half of March.

A family artistically important in the flora is *Papaveraceæ*. In the more oolitic soils and especially on mobile ground, like dunes and fig-gardens, is Hypecoum and especially the large flowered *H. ægyptiacum*.

Every botanist knows Hypecoum as a high point in the academic discussions which used to be waged over the evolutionary relationships of floral lay-out in the family-complex Fumariaceæ—Cruciferæ—Papaveraceæ. In its home field, Hypecoum strikes another note. The plants are circular, a foot or more in diameter. There is a central bunch of finely divided feathery radical leaves, and surrounding this a hedge of flowering peduncles a foot in height, each carrying numerous well-spaced canary-yellow flowers. There are two opposed broad outer petals which give to the flower a characteristic bivalved appearance, whilst the two inner petals are three-lobed and marked with conspicuous and distinctive purple-brown blotches, low down. As these flowers possess an interesting pollination-mechanism they are biologically as well as morphologically worthy of detailed study. The fruits as they ripen become long and curved like slender beckoning fingers. Until ripe they remain of a tender green colour and eventually disarticulate into numerous short cylindric one-seeded joints. Superficially Hypecoum somehow recalls a yellow Nemesia. It likes open ground where it becomes a feature in the landscape. As the scapes advance in flowering they become prostrate and radiate outwards. A plant kept in a basin will go on unfolding fresh flowers for many days, especially if exposed in a sunny window-sill.

Another interesting member of the poppy tribe is *Roemeria hybrida* with wine-coloured petals and siliqua-like capsule.

The poppies themselves (there are six species) are important in the flora, more especially in cultivated land. The most frequent, dotted about everywhere where the soil has been disturbed, is what appears to be a local strain of *Papaver Rhoeas*. The flowers are large with petals of intense crimson, generally

marked with black blotches at the base. Sometimes these blotches are outlined in white and on rare occasions they are entirely white, as in the poppy known as the Danebrog.

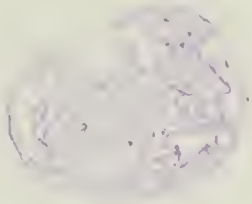
These poppies never smother the crop as field poppies in East Anglia do; moreover, their crimson is that of arterial blood, not scarlet as in our field poppy. They endure for a long time and are spaced, as by an artist, giving value to the colours of the associated plants, i.e., a finished touch to the floral landscapes they adorn. This poppy is in request for bunches as it (rather unexpectedly) holds its petals for several days.

To complete this picture of the middle phase a few outstanding plants remain to be mentioned. Everywhere, especially in the cultivation is *Chrysanthemum coronarium*, yellow, and here and there a cream-coloured strain; it is the source of many horticultural forms, though it is a question whether the original has been improved upon! This, in conjunction with *Senecio coronopifolius*, most graceful of groundsels, contributes sheets of yellow to the floral carpet in which the honours are shared with Matthiola, Carrichtera, Lotus, Trigonella and the poppies.

The following also contribute conspicuously:—White Resedas, blue *Anagallis arvensis* (pimpernel), *Linaria Hælava* (and other species), *Fagonia cretica* (Zygophyllaceæ) with large pink open rotate flowers carried low on the ground, whilst towards evening, pink Silenes brighten the waysides and borders of cultivation.

Among the gems are species of Helianthemum, nine if you please, so bountiful is the Maryut; also the choice, related *Fumana thymifolia*. Nor must the Erodiums be omitted (ten species), effective in flower and presenting us later with their long delicate silky fruits. In the barer places is a charming dwarf, gregarious Chicory (*Scorzonera alexandrina*) with mauve and occasionally white capitula.

To the last have been reserved the *Boraginaceæ*; the crowning glory as some think. They contribute everywhere to the flora their pastel colouring. This year (1938) they have been both large and unusually abundant. The habit commonly adopted is that of a circular basket or bird's nest, often a yard across, with the prostrate flowering sprays in hundreds



Description of Plate 13.

Plate 13. Upper photo. Another view at Abu Briwah, facing more W. Track on left known locally as "The Flowery Way." Seated figures are Bedouin proprietors of adjacent fig-gardens.—March 16th, 1938.

Lower photo, a fortnight later, shows figs more advanced in foliage, entry of Convolvulus (across centre) and persistence of poppies.—April 3rd, 1938.

Abu Briwah : phase of mid-March

Abu Briwah : later phase

arranged radially in successive circular patterns on the ground. The demure beauty of *Alkanna tinctoria* (sometimes "Alkanet") can only be gauged in terms of its ubiquity. Grey foliage; flowers of an arresting pale blue; that is the standard: variants of this include pale pastel rose, shades of grey fading to something just off white—like mat silver, perhaps. Nor are finishing touches wanting, as the trusses of flowers might have been dressed by the hand of an artist.

Of like habit, but bulkier, is *Anchusa hybrida* with flowers either of a deep imperial purple or a strong and penetrating blue, rarely seen in the vegetable kingdom. *Nonnea Viviana* is more bushlike with purplish flowers, and *Echiochilon fruticosum*, strayed in from the desert, a dwarf, bent, wiry little bush with small two-lipped blue flowers. There are several Buglosses very common, of which the straggling prostrate *Echium sericeum* with flowers ranging through much of the spectrum is perhaps the most pleasing.

All these and other Boraginaceæ are present in Pl. 1 and Pl. 2, lower photo, in the middle distance below the dark zone of old Asphodels, though too distant for recognition. That particular stretch of terrain is almost a pure Boraginetum.

Dotted about at this stage are numerous broomrapes (Orobanche) introducing a touch of blue into the picture. As with many other parasites their flowers are charming.

The Final Phase

This develops towards the end of March, when the Crucifers go out of flowering. At its zenith the Middle Phase approaches almost to a state of perfection which would be impaired one might suppose if any plant were removed or addition made by human hands. However, Nature is equal to the occasion, and with the decline of the Crucifers, it spreads a rose-coloured carpet of *Convolvulus althaeoides* which fills the gaps. This species of Convolvulus keeps its flowers open all day (Lower photo, Pl. 14).

The *Compositæ* now come into their own. Previously the Chrysanthemum and *Senecio coronopifolius* had taken their share, now follow the very effective *Picris radicata*, *Picridium tingitanum* and the sprawling *Launeas*. Earlier still the *Calendulas* (orange) have appeared everywhere, and some-

times on a sterile hillside a pure sward of *Calendula ægyptiaca* could be seen shining like bronze in the westering sun.

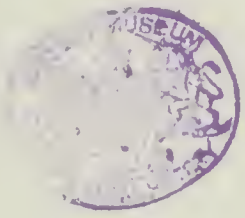
Centaureas are numerous. *C. glomerata* (yellow) common everywhere with its dense heads on the ground, the elegant rose-coloured *C. dimorpha*, in the manner of a sweet sultan, and the sessile *C. pumila* (pale rose) especially on oolite soil (lower photo Pl. 4). *C. crupinoides*, tall, much branched and blue flowered is to be found in patches here and there, and unlike most blue Centaureas it has a yellow centre and might be valuable to breeders in introducing this feature into their sophisticated cornflowers. Throughout the cultivation, is the yellow *Achillea Santolina*, a noxious weed, which must take heavy toll from the barley fields.

The thistles now become important, especially the tall, handsome *Onopordon Sibthorpianum* and *Echinops spinosus*, one of the globe thistles. Eryngiums also become conspicuous (*Umbelliferæ*). Of Compositæ there must be more than one hundred in the flora.

On the higher lands there is always an abundance of the white fragrant *Thymus capitata*, and *Phlomis floccosa* (Jerusalem sage), with dense trusses of yellow flowers, does well on stony plateaus of the garigue type. The zygophyllaceous *Peganum Hamala* (flowers cream coloured) is also a late flowering bush in the same situation.

A plant that comes into fruit by June is the curious, leafless Gymnosperm *Ephedra Alte*, to be found hanging from the sides of old quarries where it is safe from camels. The female plants are sometimes so loaded with bract-enclosed seeds, that they appear crimson from a distance. They are rather like Yew "berries," and the succulent surrounds of the seeds of Ephedra share with the Yew not only their colour, but also their slimy mawkish sweetness.

An outstanding feature of the later season is the dull rusty crimson tint assumed by much of the rocky surface of the ridges, by ancient stone-covered sites, and the like. This depends on the two Mesembryanthemums, *viz.*, *M. nodiflorum* and *M. crystallinum* (Ice Plant), in which the entire exposed vegetative organs of the former and the flowering tips of the latter develop a crimson sap. The effect is a transformation of the higher landscape, for these plants are widely distributed



Description of Plate 14.

Plate 14. Upper photo. Sward of *Mesembryanthemum crystallinum* (Ice Plant) in flower on the S. ridge. In distance on left is the N. ridge seen over the lake-bed with temple and tower. The house is the residence of Mr. W. E. Jennings-Bramly.—Mid-May, 1938.

Lower photo. Fig-garden at Abu Briwah carpetted with *Convolvulus althaeoides* which succeeds the earlier mixed flora of, e.g. Pl. 1.—6th April, 1938.

Sward of Mesembryanthemum crystallinum on ridge near Burg el Arab: on skyline (left) Abu Sir with temple and tower. mid-May

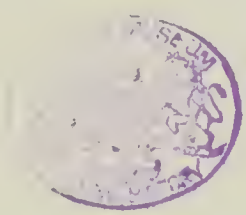
Abu Briwah : last phase (April) with Convolvulus althaeoides

Pancratium dune

Fixed dune with Thymelaea (bushes), Ononis vaginalis (dark cushions) and Centaurea pumila everywhere. Beyond are mobile dunes and the Mediterranean

Description of Plate 15.

Plate 15. Upper photo. Dune by seashore with *Pancratium maritimum* and a little Psamma. Lower photo. From near edge of fixed dunes; white mobile dunes beyond and then the sea. *Centaurea pumila* largely carpets the ground; the small dark tufts consist of *Ononis vaginalis* (yellow flowered); the bushes about 3 feet high are *Thymelaea hirsuta*. —May 8th, 1938.



and crowded to capacity on the ground. This pigmentation displays to advantage the delicate, almost diaphanous many-petalled white flowers of both species. A sward of *M. crystallinum* at the flowering stage is shown in the upper photo, Pl. 14.

By the middle or end of June all plants have finished seeding and the landscape reverts to its naked colouring till the winter rains begin.

It will be gathered from the foregoing that our landscape is ill-furnished with trees, and apart from Tamarisks and planted trees at places, this is true. Our tallest shrub is *Thymelæa hirsuta*, an evergreen which bears small yellow flowers at all seasons. It belongs to the same family as the Spurge Laurel and Mezereon. It is about 3-ft. high and grows especially on desert and stony places, it is much used for fuel. As consumption exceeds supply, the plant has to be sought at greater distances than formerly (lower photo, Pl. 15).

To complete our survey, the Lake Bed (salt marsh) and the Dunes remain to be dealt with.

The DUNES fringe the shore-line to a width of a mile or more along the greater part of the Mediterranean front of the Maryut. The great peculiarity of the formation is that it consists not of sand (silica), but of small fragments of broken shells smoothed by water into oval and rod-shaped bodies (" oolites) " of which 75 per cent. have a diameter between .3 and .5 m.m, 20 per cent. between .1 and .3 mm., whilst the rest consists of larger fragments up to 1 mm. The shore consists of this shell debris and so does the adjacent floor of the sea, so far as can be determined without actual dredging. From their microscopic characters these shell fragments appear to be of heterogeneous origin rather than the product of a single marine organism. This material is piled on the beach by onshore storms—the prevalent wind being a few degrees W. of North. The tidal range is small, not more than 2 feet. These limestone particles drift inshore and then become cemented together to form a friable rock raised several feet above high-tide marks. It may be left an open question whether this shore-line is actually rising or whether the particles are piled up by the wind to form a raised plateau which undergoes solidification. Proceeding inland at right angles to the edge of the sea, low curved ridges of lime-stone

(6 to 8 feet high) are encountered alternating with loose dune-like heaps and more level areas of the same. The seaward (i.e. N.W.) faces of these ridges are undergoing wind erosion —the wind currents being charged with limestone particles which disintegrate the rock, whilst the fretted surface is further eroded by constant friction with particles which lodge in the cavities and crannies and are whorled round and round. The erosion-forms into which this rock is cut assume the most fantastic shapes. Sometimes the top layer of this rock platform acquires a hard protecting patina through the intrusion of algæ and possibly lichens. Such patina'd slabs often project several feet—occasionally as much as 6 feet—beyond the working erosion face. Ultimately of course they cave. The long persistence of this excessive overhang is because access to the shore is restricted as an anti-smuggling measure. Otherwise the projecting slabs and brackets would be trimmed off by tread of feet.

The orientation of the curved ridges referred to is difficult to determine by mere inspection at ground level, but an air photograph (Pl. 16, upper photo) taken at 4,000 feet, shows their relations with the clarity of a diagram. These crescentic ridges of limestone have their concave faces, which are vertical, directed N.W. and, the sun shining (in the photograph) on their convex (S.E.) faces, the concave sides between the cusps appear in shadow. These crescents often show a central cusp, others none, and yet others several. Doubtless there is a simple explanation of this varying rate of cutting that leads to these appearances—such as eddies and " backwaters," but my own observations are too fragmentary to justify further discussion here. To give an idea of the dimensions it will suffice to say that the large conspicuous crescent in the upper photo (Pl. 16, left-hand bottom corner) is about 350 feet from outer cusp to outer cusp. Some are wider than this and others, the majority, narrower.

Anyone who has seen free crescentic sand dunes (barchans) on a desert, or even photographs, will be struck by the similarity in form between them and these eroding limestone ridges. True, the cusps of a barchan are directed down wind, whilst the cusps of these disintegrating limestone ridges are directed up wind. Nevertheless the analogy may be significant, for

Air Photo of eroding limestone ridges among the dunes.
Distance R to L 650 yards

Dry lake-bed with Suæda, Obione and Sphenopus sward:
N. ridge on sky-line with Temple and tower at Abu Sir

Description of Plate 16.

Plate 16.— Upper photo. Air-view of mobile dune region with crescentic ridges of consolidated shell fragments ("oolites") undergoing wind erosion. For description see p. 417. In top left-hand corner young fig-plantation, the right-hand part of which, recently planted, has parallel lines of hurdles as windscreens; these throw shadows. Scale 1/6500.

Lower photo. Dry lake-bed with tufts of Suæda Obione, etc. Between the tussocks sward of low grass Sphenopus. In distance stock grazing. Northern ridge on sky-line with temple and tower at Abu Sir.—Mid-May.

there are observations relating to barchans tending to show that their advancing concave faces are not just the result of sand blown over the top of the dune falling as a talus, but that actually the concave advancing face of a barchan is regulated by an eddy which works round to the front and erodes the advancing face. If gliders could operate in the strong winds which drive and control the form of barchans, we should soon learn all about the relation of the air currents to their various surfaces, and whether an explanation on the theory outlined is tenable.

Returning to the dune-vegetation; though composed entirely of limestone the dunes behave physically, precisely like other dune types. The particles are blown by the wind and come to rest where vegetation is established. The most widely spread plant is Psamma (Marram Grass) which, though forming a rather sparse covering—judged by more northern standards—performs adequately its holding function. Its thinness is partly attributable to casual grazing.

Another plant important here in dune-building is *Pancratium maritimum*, dominant in many places. These are bulbs always deeply buried, with tufts of long ribbon-shaped leaves, whilst inflorescences of white Narcissus-like flowers are produced in late summer. Seeds scattered on the surface freely germinate. The bulbs, which are very large, occur at a depth of 2 feet or more, and there is little doubt that they are buried largely through the agency of contractile roots. A photograph of a Pancratium-dune is shown in Pl. 15, upper photo.

Reference has already been made to *Colchicum Ritchii*; this is very abundant on the dunes, flowering at the end of December. It is a delicate, small-flowered species of the genus, pale rose-coloured and sweetly scented. Another plant of distinction on these dunes is *Hypecoum ægyptiacum* (and other species). In distribution it is "locally abundant" and its period mid-season.

Scattered everywhere are the spherical tufts of *Ononis vaginalis*, a rest-harrow which covers itself with densely-crowded yellow flowers. For these (lower photo, Pl. 15) our shining white dunes form an effective background. This Ononis is a very deep-rooter, and the Bedouins when establishing a fig-garden on the dunes pass a harrow over the surface to uproot

them and prevent their robbing the figs of deep stored water. The fig grown is the variety "Sultani" and as it commands a good market, the Bedouin does what he can to make his crop remunerative. Were it only for home consumption, he would not put himself to all this trouble.

Covering many parts of the inner dune zone is the charming sessile pale pink *Centaurea pumila* (see lower photo, Pl. 15), prostrate on the ground amongst the dark Ononis and playing a major part in fixing the surface.

The sea spurge, *Euphorbia Paralias*, known on the S. coasts of England, is probably Mediterranean in origin. Here it is abundant.

A curious plant of these dunes is a rose-coloured Campion with fleshy leaves, *Silene succulenta*, perhaps the most obviously succulent plant in the whole flora. Of importance as a dune builder is *Retama Rætam*, a white-flowered, sweet scented broom which forms great bushes near the sea and covers itself with blossom in the early mid-season. Where much "sand" is collected the broom-covered hummocks reach the size of small hay-stacks. The flowers are either all white or, more usually, they carry a purple spot.

Two lesser plants brighten all our dunes, *viz.*, the intensely blue-flowered *Salvia lanigera* and the silvery-leaved *Lotus polyphyllos*.

A curious feature of the tide-mark, and ultimately through wind carriage, of the dunes themselves, is the immense number of *Poseidonia*-balls which come ashore. They derive from a marine ally of the pond weed, Potamogeton. Rhizomes of this plant with attached ribbon-like leaves are uprooted, and as they drift the soft tissues of the leaves become macerated and disintegrate—the fibres only remaining. These fibres become woven into fairly compact spherical or oval masses by the motion of the waves. They look like hairy tennis balls, and on dissection, remains of the rhizome may be found embedded within. In Western Australia similar balls come ashore (or came ashore in olden times) and become buried in thick seams in the sand: the proposal has been made that they should be exploited as a source of paper-making material.

The Salt Marshes—here the dry bed of Lake Mareotis which occupies the floor of the valley between the two parallel

ridges for a distance of about forty miles from Alexandria. The Lake being interrupted by a causeway near Amria, the whole of this western arm is dry, except that a certain amount of rain-water collects on it in winter. In olden times this arm was navigable and as Lake Mareotis was thus connected with a branch of the Nile (since silted up) there was continuity of fresh water from Egypt proper to the Maryut. That this was extensively used, the remains of jetties, piers, and other waterside facilities at Abu Sir, Mareotis, and elsewhere, bear testimony. To-day all this is altered and in its place we have a highly saline marsh. For the most part it carries a permanent vegetation of low-tufted shrubs, recalling in this respect the extensive Suæda and Obione flats that are such a characteristic feature of the marsh flats in East Anglia, as at Scolt Head and Blakeney Point. With this landscape, East Anglians would be perfectly at home (lower photo, Pl. 16).

The separate treatment of the salt marshes here followed, depends on the fact that their vegetation is composed of plants quite different from the mainland, and also their flowering season is, as in England, two months later than that of the generality of the flora. Botanically, the lake-bed is distinct.

The staple covering of the marsh consists of mingled tussocks of *Suæda fruticosa*, *pruinosa*, and other species, *Atriplex* (*Obione*) *portulacoides*, larger and smaller jointed and leafless Salicornia-like forms—*Halocnemum strobilaceum*, *Arthrocnemum*, *Salicornia fruticosa* and *lignosa*, an occasional *Inula crithmoides*, patches of *Juncus maritimus v. arabicus*, frequent *Iris Sisyrinchium* and *Frankenia* with bright flowers, and large numbers of the grey-leaved *Limoniastrum monopetalum*.

The height and density of the bushes is such that a car with fairly high clearance can generally make its way bumpily anywhere, as the Suædas are kept low by the grazing of camels. Actually these bushes can be easily grubbed up and roads provided at the rate of a kilometer a day by a small squad of Bedouins. In this way a useful system of roads has been provided. The surface is hard and perfectly level; there is entire freedom from scattered stones, and the scenery is delightful. In winter, with rain-water lying, they cannot be used.

By the end of April the marsh comes to life and as new growth is pushed and flower buds develop, a general colour-change becomes manifest. The height of the flowering season is the third week of May, the most conspicuous plant being *Limoniastrum monopetalum* (Plumbaginaceæ). This rather rigid plant holds its inflorescences well above its glaucous foliage and seen against a low morning sun as you dash past it, there is an element of incandescence about these upward reaching lavender torches.

The sea lavender on the marshes between Wells and Stiffkey in August is in its way a world record, but its heads are dense, less vibratile and luminous, and the touch of fire is wanting. The background is provided by the varied Salicornia-tribe, already mentioned. Two species of Sea Lavender are important here; *Statice pruinosa* with its formal horizontally-patterned inflorescences on the higher marsh levels, and sheets of *Statice delicatula* standing high above the rest and rippling for acres in the wind. *Statice Limonium* is present, but plays no part here— Stiffkey remains supreme. So much for mass effects.

Two other Statices abound in the district on rocky ground especially, and hardly at all on the marsh. As specimen plants I have always thought them the pick of the genus; they are not found in seedsmen's lists. These are *Statice tubiflora*, a prostrate form with trusses of unusually large deep rose-pink flowers, lasting for three months, and *Statice Thouinii* an erect type with winged stems and dense heads of pale blue (sometimes white) flowers. They are both unusual and might be tried in sheltered positions in rock gardens at home.

In places on the lake-bed are occasional patches of *Juncus maritimus* v. *arabicus*, and of the reed *Phragmites communis*.

Between the scattered tufts of marsh plants in open formation a low dwarf wiry grass *Sphenopus divaricatus* forms extensive swards of great tenuity so that it is not easy to distinguish between the plants and their shadows on the mud. As the season advances Sphenopus turns a bright umber colour, conspicuous from afar. (Pl, 16, lower photo.).

The Season of 1938.

This year's display has exceeded anything seen in the Maryut almost in living memory. The older men say one

has to go back forty-one years for its like. In the nine years I have known the flora 1930 was good, then followed seven lean years, and now in 1938 comes this miraculous spectacle. A chief factor, no doubt, is a rainfall starting early and continuing at suitable intervals. Here is the record taken at the Burg-el-Arab station for the winter 1937–38, for which I am indebted to Mr. T. W. Brown, Director of the Horticultural Section at Giza.

Oct.	81 mm.	Jan.	65 mm.
Nov.	35 mm.	Feb.	48.5 m.m.
Dec.	16 mm.	Mar.	11.5 mm.

total 257 millimeters—approximately 10 inches.

In most years since 1930 the rainfall has been half this or less. The station (Burg) is five miles south of Abu Sir and may be taken as typical for the Maryut as a whole.

The spacing in time is perhaps at least as important as the actual total amount of rainfall. But there is probably more to it than this. This season the temperatures have been continuously cool, night minima averaging not below 45°F., and day maxima rarely above 75°F. There has been an absence of frost, and, probably more important, of those warm spells (90° to 95°F.), which have a way of intruding themselves unseasonably. Where these are accompanied by winds off the desert (Khamsin conditions) the results are devastating. Favoured in this way the plants steadily progressed, elaborating their vegetative organs and a fine reserve of flower buds without being either checked or forced, so that when the temperature eventually rose there was a wonderful response in flowering. In a small way the same sequences and responses were noticed in my own garden, so that wild and cultivated plants appear to react identically.

Nor is this the whole story. Let it be put in this way. Suppose all these favourable conditions to be repeated in 1939, would the display rival that of 1938 ? I take a risk in saying I think not. It would be good, yes, but not supreme. And for this reason. Much depends in the Maryut in cropping barley (where manuring is not practised) on the interval during which the land lies fallow. In this way fertility is re-established. *Mutatis mutandis* this should apply to the wild flora also.

To judge from rough, unchecked memory, I should estimate the total bulk of above-ground vegetable production in 1938 at about ten times the average production of the seven lean years, 1931 to 1937, and three times that of the " good " year, 1930—anyway those are the sort of magnitudes we have to deal with. This means that if production in 1938 was to the capacity of the soil fertility, or anywhere near it, then the preceding lean years were in effect of the nature of fallow years. In other words 1938 was a cumulative result, depending on the unexhausted surpluses of those lean years. Consequently I should not expect 1939 to rival 1938, however apparently favourable the accompanying conditions might be.

Perhaps the closest analogy with what I have been attempting to describe in the Maryut, is the miraculous outburst of flowering and general luxuriance shown, especially by annual plants, when rich pasture-land is broken up and converted to the purposes of a flower-garden. Here the effect does not persist at that high level, but soon drops to normal. It may be that factors other than accumulated salts and favouring meteorological conditions are involved. Again, related but different, are the " bumper years " for single species of plants so often observed, and the problems there involved. These strike deep into the matter of plant-welfare generally and their importance is obvious. Some day perhaps a little " Rothamsted Station " may be established to deal with problems arising from the natural flora.

Insect Interlude.

Throughout the flowering season just described there was a remarkable dearth of insects, in strong contrast to what we are accustomed to. Thus, a black hornet which usually in great numbers darts about at high velocity just clear of the herbage, failed to arrive till May, whilst the " rose-beetle," a pest in the flower garden, never appeared at all. Professor Efflatoun Bey (a leader in the entomological world) who regularly visits the Maryut for insects at the height of the flowering, and secures species by the hundred, told me, disconsolately, he could find nothing this year. It is a complex problem, and I can only conjecture that the insects " missed the boat " on account of the prevailing relatively low temperatures. Such lapses in time-adjustment between the hunter

and his prey are not unknown in other biological fields. Lest I paint too black a picture, it may be added that already in January I found numerous small green caterpillars feasting on the ovaries of the anemones in certain "pools" on warm south-facing exposures. Their method was to work systematically over the convex receptacles of these flowers, clearing the soft young carpels, but like epicures, touching nothing else. I judged not more than .1 per cent. of the flowers in the pools affected were thus attacked. In quantitative terms this would mean 500 cases in a pool of half-a-million flowers.

These observations, though perhaps trifling, seem worth placing on record for a district where there are few observers.

The Future of the Maryut.

So much for the humdrum inventory of the plants in their seasons. The Maryut is certainly the garden of Egypt. Though its area is perhaps less than 1/200th of the whole country, it carries approximately one-third of the total flora.

And now for a glance into the future. The effectiveness of our rich flora, the touch that gives it pre-eminence, is largely an unconscious contribution by the Bedouins. Their easy technique, a scratching of the ground, provides conditions that could not be bettered. Will this withstand the test of time, the encroaching outer world, for assuredly change is coming?

Already in the Amria-Ikingi country (twenty miles from Alexandria) there is a growing week-end and residential settlement, with cultivation under irrigation; at Burg (twenty miles further out) an expanding Horticultural Station is filling the landscape with its verdure, whilst further west in the Hammam country enterprising spirits are raising crops and trees. What can be done at these places can be done everywhere.

The task looks impossible when you are first confronted with a parcel of desert to cultivate, but the moment the ground is broken up and water brought to it, you are spurred to further effort by the fertility revealed. Such lightning results should attract recruits. Already we have noted the amazing spread of fig-gardening in the coastal zone. Can and will the

Bedouin go the pace? Or will he—a wanderer—be pushed out into the desert by those more fitted to produce from the soil the greater return which the taxes will require? The best opinion, I find, inclines towards the latter alternative.

And from another direction change is coming. Hitherto the Maryut has had to rest content with rough roads which are no pleasure to ordinary motorists unless the desert attracts them for its own sake; whilst after rain these roads are practically unusable. This year a main macadamised road from Alexandria to Cyrenaica is under construction and this will run largely along the seashore. As it will be one of the most attractive driving roads in the world it should bring hosts of users, and this will mean eventual rest-houses, resorts and settlement, including "ribbon-development."

Some far-sighted authority (public or private) will realise that development depends primarily on a reliable source of potable water, and when such provision has been made things will go ahead. When it is remembered how congenial is the N. African seaside climate at all seasons, a "Riviera" may be foreseen. In fifty years the country will be unrecognisable and even in twenty there will be great changes. Incidentally all this should provide an assured market for local produce.

That the Maryut will be developed seems to me inevitable, and its future will depend on the wisdom and vision of the Egyptian government. They have before them the examples and warnings of many developed coast-lines the world over, and these should be a help in deciding what to do and what to avoid.

That there will be artificial production of flowers seems likely—there will be "Haarlems" and even "La Mortolas." But somehow one hopes the character of the Maryut may survive. Perhaps, when the Bedouins begin to feel the strain, reservations or sanctuaries will be set aside for them (and it were better to do this earlier rather than later). In these, their cultivations will continue on existing standards and the wild flora will go on enjoying the traditional "desert hospitality" to which we owe so largely these yearly carpets of vivid colour.

Select List of the Maryut Flora.

As an appendix, a list of about 3/5ths of the Maryut Flora is here included.

The families (Natural Orders) are arranged alphabetically under the major classes *Gymnosperms*, *Monocotyledons* and *Dicotyledons*.

In brackets following the name of each Family will be found the number of species, of which selected representatives are enumerated.

I am indebted to Mrs. Vivi Täckholm, a leading authority on the Egyptian Flora generally, for the use of her extended hand list.

Gymnosperms.

Gnetaceæ (1).

Ephedra Alte

Monocotyledons.

Amaryllidaceæ (4).

Narcissus Tazetta

Pancratium maritimum

Araceæ (3).

Arisarum vulgare

Helicophyllum crassipes

Cyperaceæ (25).

Carex extensa

Scirpus supinus

—— mucronatus

—— litoralis

Cyperus lævigatus

—— difformis

—— esculentus

—— longus

Gramineæ (109).

Bromus scoparius

—— fasciculatus

Vulpia bromoides

Sphenopus divaricatus

Briza minor

——maxima

Aeluropus lagopoides

Cynosurus coloratus
Lamarckia aurea
Ammochloa palestina
Arundo Donax
Phragmites communis
Aegilops longissima
Elymus Delileanus
Hordeum murinum
Schismus barbatus
Koeleria pumila
Corynephorus articulatus
Psamma arenaria
Polypogon monspeliensis
Stipa Lagascæ
Aristida lanata
—— plumosa
Cynodon Dactylon
Lygeum Spartum
Phalaris canariensis
Paspalum distichum
Panicum miliaceum
Echinochloa colonum
Setaria lutescens
Cenchrus ciliaris
Imperata cylindrica
Saccharum spontaneum

Iridaceæ (2).
Gladiolus segetum
Iris Sisyrinchium

Juncaceæ (5).
Juncus acutus
—— maritimus v. arabicus
—— Fontanesii

Liliaceæ (39).
Asparagus stipularis
Asphodelus microcarpus
—— tenuifolius
Allium mareoticum
—— desertorum

—— Erdelii
—— roseum v. Letourneuxii
—— Aschersonianum
Urginea maritima
Muscari comosum
—— bicolor
—— racemosum
Hyacinthus sessiliflorus
—— macrobotrys
—— mauritanicus
Scilla peruviana
Ornithogalum tenuifolium
Gagea fibrosa
Colchicum Ritchii

Typhaceæ (1).

Typha angustata

Potamogetonaceæ (8).

Posidonia oceanica
Ruppia maritima
Cymodocea major
Zostera nana

DICOTYLEDONS.

Aizoaceæ (4).

Mesembryanthemum nodiflorum
— crystallinum

Amaranthaceæ (1).

Amaranthus gracilis

Boraginaceæ (26).

Heliotropium europæum
Echiochilon fruticosum
Anchusa hybrida
—— aggregata
—— hispida
Nonnea Viviani
Alkanna tinctoria
Lithospermum callosum
Arnebia hispidissima
Echium setosum
—— sericeum

Capparidaceæ (2).
Capparis spinosa
Gynandropsis pentaphylla
Caryophyllaceæ (36).
Vaccaria segetalis
Silene succulenta
—— villosa
—— rubella
—— cerastioides
—— nocturna
—— sericea v. colorata
Arenaria serpyllifolia
—— procumbens
Stellaria media
Spergularia marginata
—— salina
—— diandra
Polycarpæa tetraphylla
Herniaria cinerea
Paronychia nivea
—— argentea
Gymnocarpus fruticosus
Chenopodiaceæ (37).
Beta vulgaris
Chenopodium album
Atriplex hastata
—— portulacoides
—— Halimus v. Schweinfurthii
Halocnemum strobilaceum
Arthrocnemum glaucum
Salicornia herbacea
—— fruticosa
—— lignosa
Suæda fruticosa
—— pruinosa
—— hortensis
Haloxylon articulatum
Anabasis articulata
Cistaceæ (10).
Fumana thymifolia

Helianthemum ledifolium
—— ciliatum
—— ellipticum
—— Lippii
—— kahiricum

Compositæ (101).

Echinops spinosus
Carlina involucrata
Atractylis flava
Onopordon Sibthorpianum
Centaurea pumila
—— glomerata
—— dimorpha
—— pallescens
—— calcitrapa
—— crupinoides
Evax contracta
Ifloga spicata
Filago mareotica
Phagnalum rupestre
Helichrysum conglobatum
Inula crithmoides
Odontospermum pygmaeum
Ambrosia maritima
Anthemis Cotula
Anacyclus alexandrinus
Achillea Santolina
Diotis maritima
Matricaria Chamomilla
—— aurea
Chrysanthemum coronarium
Artemisia monosperma
—— judaica
—— herba-alba
Senecio coronopifolius
Calendula aegyptiaca
—— arvensis
Hyoseris lucida
Leontodon hispidulus
Picris radicata

Scorzonera alexandrina
Launea nudicaulis
Crepis bulbosa
—— senecioides
Picridium tingitanum

Convolvulaceæ (12).
Convolvulus lanatus
—— althæoides
—— siculus
Cressa cretica
Cuscuta arabica

Crassulaceæ (2).
Umbilicus pendulinus v. horizontalis

Cruciferæ (50).
Sisymbrium Sophia
—— Irio
Malcolmia torulosa
Matthiola humilis
Farsetia longisiliqua
Diplotaxis erucoides
Brassica campestris
—— Tournefortii
Eruca sativa
Erucaria microcarpa
Cakile maritima
Zilla spinosa
Enarthrocarpus lyratus
Carrichtera annua
Moricandia clavata
Lepidium Draba
Biscutella Columnae

Cucurbitaceæ (2).
Bryonia cretica
Citrullus Colocynthis

Dipsaceæ (4).
Cephalaria syriaca
Scabiosa arenaria

Euphorbiaceæ (12).
Mercurialis annua

Euphorbia mauritanica
—— helioscopia
—— Peplus
—— Paralias
—— Peplis

Frankeniaceæ (2).
Frankenia hirsuta
—— pulverulenta

Gentianaceæ (3).
Erythræa maritima
—— spicata

Geraniaceæ (13).
Geranium molle
Erodium hirtum
—— glaucophyllum
—— chium
—— moschatum
—— ciconium
—— cicutarium

Globulariaceæ (1).
Globularia arabica

Labiatæ (13).
Thymus capitatus
Salvia ægyptiaca
—— lanigera
Phlomis floccosa
Teucrium Polium
Ajuga Iva

Leguminosæ (94).
Retama Rætam
Ononis vaginalis
—— sicula
—— serrata
Trigonella stellata
—— maritima
Medicago marina
—— lupulina
Melilotus sulcatus
Trifolium fragiferum
—— stellatum

Anthyllis vulneraria
Lotus edulis
—— ornithopodioides
—— polyphyllos
—— creticus
—— corniculatus
Scorpiurus muricata
Hippocrepis bicontorta
—— cyclocarper
Astragulus bæticus
—— hispidulus
—— mareoticus
—— alexandrinus
—— Forskalii
Onobrychis Crista-galli
Alhagi maurorum
Vicia sativa
——calcarata
Lathyrus Aphaca
—— marmoratus
—— Cicera

Linaceæ (2).
Linum strictum

Lythraceæ (7).
Lythrum tribracteatum
Ammannia baccifera v. ægyptiaca

Malvaceæ (8).
Malva parviflora
Lavatera cretica
Hibiscus Trionum

Orobanchaceæ (7).
Orobanche minor
—— cernua
—— ægyptiaca
Cistanche lutea

Oxalidaceæ (1).
Oxalis corniculata

Papaveraceæ (18).

Papaver hybridum
—— humile
—— Rhœas
—— dubium
Roemeria hybrida
Glaucium corniculatum
Hypecoum ægyptiacum
—— deutero-parviflorum
Fumaria densiflora
—— judaica

Plantaginaceæ (11).

Plantago squarrosa
—— Coronopus
—— major
—— albicans

Plumbaginaceæ (7).

Statice Thouinii
—— delicatula
—— pruinosa
—— tubiflora
Limoniastrum monopetalum

Polygonaceæ (15).

Calligonum comosum
Emex spinosus
Polygonum aviculare v. litorale
—— equisetiforme
—— maritimum
Rumex ægyptiacus
—— vesicarius

Primulaceæ (4).

Samolus Valerandi
Anagallis arvensis

Ranunculaceæ (13).

Ranunculus asiaticus
—— sceleratus
—— muricatus
Adonis flammeus
—— microcarpus

Anemone coronaria
Nigella Tauberti
Delphinium nanum

Resedaceæ (9).
Reseda decursiva
—— alba
—— lutea
—— pruinosa
Caylusea canescens
Oligomeris subulata

Rosaceæ (3).
Poterium verrucosum
Neurada procumbens

Rubiaceæ (7).
Vaillantia hispida
Galium tricorne
Crucianella maritima

Rutaceæ (1).
Haplophyllum tuberculatum

Santalaceæ (1).
Thesium humile

Scrophulariaceæ (12).
Linaria parviflora
—— Hælava
—— joppensis
Antirrhinum Orontium
Veronica Tournefortii
—— Anagallis

Solanaceæ (11).
Solanum nigrum
Lycium vulgare
Datura Metel
—— Stramonium
Hyoscyamus muticus

Tamaricaceæ (5).
Tamarix articulata
—— gallica
Reaumuria hirtella

Thymelaceæ (1).

Thymelæa hirsuta

Umbelliferæ (23).

Eryngium creticum
—— campestre
Bupleurum nodiflorum
Pithyranthus tortuosus
Fœniculum vulgare
Crithmum maritimum
Malabaila suaveolens
Daucus litoralis v. Forskalii
Torilis nodosa
Cuminum Cyminum

Urticaceæ (3).

Urtica urens
—— pilulifera
Parietaria judaica

Valerianaceæ (2).

Valerianella Petrovichii

Verbenaceæ (3).

Lippia nodiflora
Verbena officinalis

Zygophyllaceæ (6).

Peganum Harmala
Fagonia cretica
Tribulus terrester
Nitraria tridentata

VII

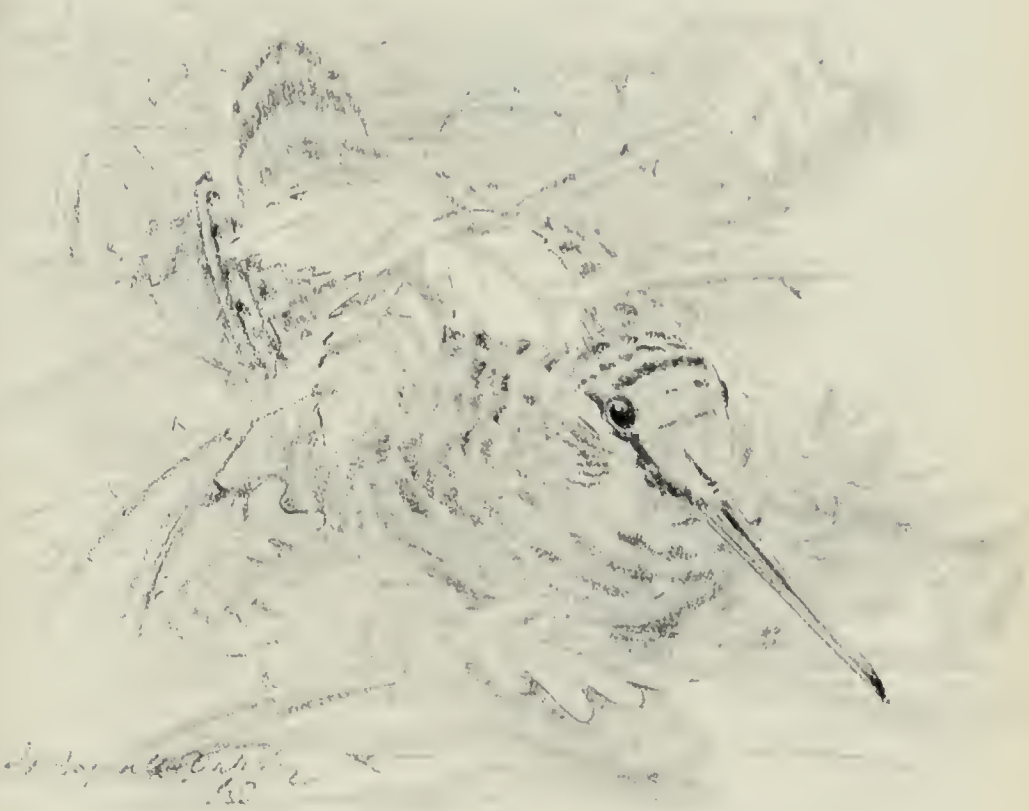
MORE OBSERVATIONS ON THE NESTING WOODCOCK

By R. P. Bagnall-Oakeley

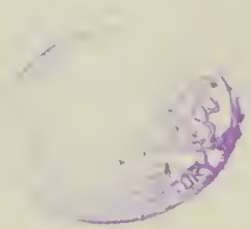
The following observations make no pretence of forming a coherent description ; they are records of isolated occurrences and ideas connected with nesting woodcock.

In the vicinity of Holt, nesting woodcock seem to be on the increase, at least temporarily. This year I knew of no less than fourteen nests, nine of which I actually visited, and seven of which I found myself. Three of the more accessible of these were closely watched, especially during the evening. Three of the nests were in the same wood, two of them close to nesting sites of former years, though whether they were the same pairs or their progeny which had returned, could not be ascertained.

There appears to be a large variation in the time of nesting. The earliest nest hatched at the beginning of the fourth week in April, while the last was as late as the beginning of July. In six of the nests incubation took place during the middle weeks of May and only two were earlier than this. Most authorities seem to be agreed that April is the usual nesting month, but whether these observations are based on English or foreign nests, I cannot tell. That the late nests are due to earlier nesting attempts being unsuccessful is doubtful, since the birds do not frequently desert, unless continually flushed and the eggs regularly interfered with or broken. For though the woodcock requires a quiet and secluded breeding site, it will tolerate a remarkable amount of disturbance once it has started incubating. Several nests were visited daily and sometimes twice a day by two or three boys at a time from Greshams School ; though the birds were seldom flushed they were closely approached, and sometimes ran off the nest unobserved by the intruders, but they did not desert. Nesting woodcocks, in common with most other ground game, suffer considerably from stoats and jays, though the depredations of these robbers would hardly account for so many enforced second and even third nesting attempts. Birds nesting as late as the middle of June—and such birds were observed this year—must either have encountered a series of nesting mishaps or have been doubled-brooded. I have never seen it suggested



Crouching woodcock, aware of being watched.



anywhere that the woodcock was double-brooded, though the regular occurrence in the last few years of late nests seems to support such a supposition in the case of some pairs of birds. There appears to be little doubt that the snipe is sometimes double-brooded, and I have no doubt that the woodcock is also double-brooded.

Another point of interest which needs investigation is where our nesting woodcock have come from. Are they the birds which have been in the neighbourhood since the late Autumn or Winter or have they returned from other countries? This year in looking for early nests and watching for " roading " pairs, the lack of woodcock was very apparent. Only a single bird was observed after the third week in March until the first nest was found, and a very bad nesting year was consequently expected. But the larger number of nests than usual suggests the arrival of birds from elsewhere, almost certainly from the *South or East*. It may have been that the birds were about the district the whole time, but were especially elusive, before beginning to nest, though it is improbable that their evening flights, which usually begin some time before breeding, would have been overlooked.

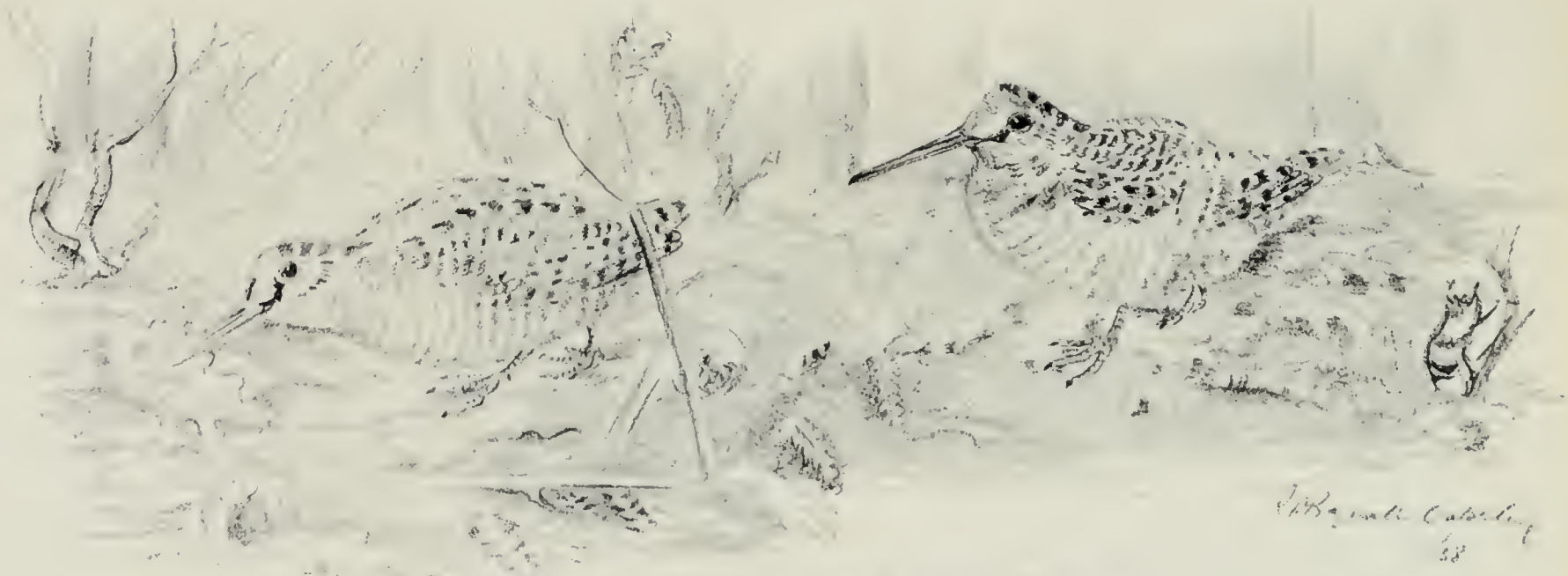
On the other hand the supposition that the birds are new arrivals from the continent, is corroborated by the fact that spring migration is awaited eagerly by shooters in Belgium and Holland, when the woodcock are most numerous. The birds are shot when taking their evening flights and in some seasons large numbers are killed. Our nesting birds may well arrive from these countries or directly from the south, and very likely they are already paired when they get here.

The nature of the nesting sites varied very little. The nine nests which were actually visited, were all covered with some kind of undergrowth or dead branches. Six were among brambles, but these were not at all thick, and though they were sufficient to make photography ineffective, yet they formed a very incomplete covering. This covering, however, broke up the general flatness of the ground and made the protective coloration of the birds when on the nest more effective. The blotched shadows too, helped the camouflage of the nests, a factor which is especially necessary when the birds are not sitting. Of the other three nests, one was in a

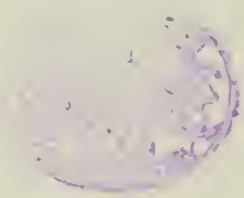
pine wood under a slight covering of dead bracken, one in a birch wood amongst the scanty twigs of a fallen bough and the third among small scattered rhododendron bushes in an oak wood, with little direct cover at all. The preference for pine woods is especially marked; all of these six nests were situated in them, while the descriptions of the location of four of the others that were not visited, showed that they were similarly placed among pines. One fact in particular was noted in connection with one of the nests in a wood of Scotch pines. The only lining to the slight hollow of the nest was a number of oak leaves and the nearest oak tree was more than 250 yards away. None of the nests seemed to have had a hollow deliberately scraped out to accommodate it. They appeared to be the impressions caused by the weight of the sitting birds, and these grew slightly deeper, as might be expected, as incubation proceeded. A few small twigs sometimes lined the nests and the nature of these suggested that they had been collected from close at hand.

A great deal has already been written about the protective coloration of the woodcock and to discuss this property at all fully would run the risk of plagiarism. One point, however, once noticed, became increasingly apparent. No matter what conditions of light prevailed, the protective coloration was always good, but when the sun shone brightly and the intensity of light and shade became more marked, the sitting bird invariably appeared less conspicuous. When the richness and contrasted nature of the colours of the woodcock is considered, this fact is hardly surprising, for the bird then merges better into its surroundings. The variation in colour between individual birds was also considerable. In some the richness of the reddish brown was intense, while in others all the browns were of a more greyish hue. One bird in particular was far more sombre in colour than the others and this bird seemed to be more conspicuous when sitting.

The long forehead and large eyes of the woodcock are features mentioned in most descriptions of the bird, but one characteristic that usually passes unnoticed is the placing of the eyes in the head. They are very far back and very high, so that the bird is able to see almost directly above it, even when in a crouching position. One nest which was watched, was



Feeding near the nest on a frosty evening



surrounded by fir trees, but directly above it was a space open to the sky. The sitting woodcock seldom failed to observe any large bird that passed overhead, though it could not have seen the other's approach until it was almost above it. Frequently the brooding bird would turn its head on one side, the better to observe some gull or rook as it glided overhead.

The behaviour of one pair of birds during the very hard frosts which occurred this year at the end of the second week in April, deserves mention. Woodcock are reputed to be unable to stand spells of hard weather. The pair referred to seemed especially conscious of the cold. Incubation had just begun and the birds usually left the eggs uncovered for several hours each evening, while they went to their feeding ground. At this time, however, the return of the non-sitting bird to the nest in the late evening, was not the usual signal for its mate to leave. Instead the bird which had been sitting moved off the nest and immediately began to turn over flat slabs of half-frozen leaves and small pieces of dead wood in the vicinity of the nest. The beak was used very cleverly to locate insects and other small items of food, which the bird appeared to devour before withdrawing its beak, from under the leaves. Both birds routed noisily about for more than an hour, one or other of them returning at intervals of about ten minutes to sit on the eggs for a short time. If this kind of behaviour is usual during spells of frosty weather, it must happen frequently in the normal nesting countries where such periods of hard weather are more common, but I have never seen it mentioned.

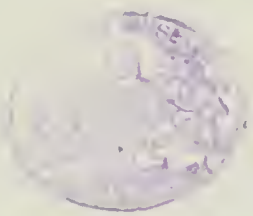
In common with most ground nesting species, woodcock turn their eggs at frequent intervals. The frequency of this operation appears to vary with the individual, for one pair was observed to neglect turning the eggs for two days at a time. This was determined by marking the eggs and recording their exact position in the nest after the bird had left for its evening flight to feed. The position of the eggs sometimes remained almost the same for forty-eight hours. Nevertheless they all hatched successfully. It was suggested to me by one ornithologist that the bird may have turned her eggs with such regularity and precision that they arrived in the same position every twenty-four hours !

As to the number of eggs in the clutch, four appears to be the usual number for the early nests, and three for the later ones. This would appear to support the assumption that the late nests are second attempts, the previous clutches of four having come to grief. It would, however, be reasonable to argue that the previous clutch of four had been successfully hatched, though it is true that the second nest follows the first more quickly if the earlier one is deserted, so that the second clutch might be expected in this latter case to be smaller than normal.

With regard to the carrying of young, I have no substantial evidence to support this generally accepted belief. The only fact observed which would tend to support it, was that in the case of one nest the young were seen to hatch in the late morning and early afternoon, though when the nest was revisited in the evening they had gone. A thorough search of all the ground round the nest was made with a dog with a good nose for Woodcock, but nothing was found and the family never returned.

The flights to the feeding grounds were again closely watched. The birds seldom seemed to leave the wood where they nest, in a direction that would take them straight to their feeding place. But the course is not so abruptly angular as was described in my previous observation, though in general the principles of it remain the same. One pair of birds in particular were remarkably punctual in their time of departure, the maximum variation from their average time—9.10 p.m. being 2 minutes.

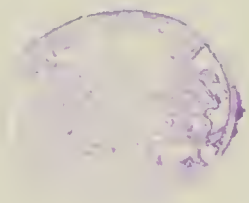
The evening flights of families of woodcock was again seen on several occasions towards the end of June. As previously recorded the birds twisted and turned, dived and climbed in quick succession, now in the rides between the trees and now over the tree tops. By August all signs of woodcock had disappeared. Not a single bird was seen after the fourth week in July. Presumably they had moved on northwards, and will return again this winter or more probably next spring.




Sitting Woodcock

Family of Woodcocks at Evening Flight

W. Wagstaff Baker & Co. 1858



VIII

NORFOLK AND SUFFOLK LOCAL NAMES OF BIRDS.

The following list was first collected by the Junior Naturalists, but it has been added to by others who have been consulted in different localities.

Names in *italics* are not included in Ticehurst's "Birds of Suffolk" and appear to be more especially of Norfolk usage; most of the others are common to both counties.

Those who obtain their living on the coast often employ terms which are not used inland.

Names such as butcher bird for red-backed shrike, which are used all over the country and have no particular connection with East Anglia, have been omitted.

HOODED CROW: *Kent Crow*, Kentish Crow, *Danish Crow*, *Danishman* (Wells), *Denchman*, *Woodcock Crow*.

JACKDAW: *Cadder*.

HAWFINCH: *Cobble-bird*.

GREENFINCH: Green Linnet, *Green-ulf*, *Greeny*.

GOLDFINCH: *Draw-water*, King Harry.

TWITE: *French Linnet*.

LINNET: *Blood-linnet*, Red Linnet, Grey Linnet.

BULLFINCH: Blood-ulf, *Red Linnet*, *Red-olph*, *Nope*.

CROSSBILL: *Robin-hawk*.

CHAFFINCH: Spink, *Wheatsel' Bird*.

TREE SPARROW: *French Sparrow*.

CORN BUNTING: *Leg dangler*, *Gule*, *Guler*, *Bunt-lark*, Clod-bird.

YELLOW BUNTING: *Guler*, *Guley*, *Gule*, *Scribbling-finch*, *Gule-bunting*, *Gule-finch*.

REED BUNTING: *Blackcap*, *Reed-Sparrow*.

SNOW BUNTING: Snow-bird, *Snow-man*.

MEADOW PIPIT: Titlark, *Ground-lark*.

ROCK PIPIT: *Mudlark* (Breydon).

YELLOW WAGTAIL: *Cow-bird*, *Yallow Wangtail*.

PIED WAGTAIL: Penny Wagtail, *Dishwasher*, *Black Wagtail*

GREAT TIT: Blackcap, *Bee-bird*, *Ox-eye*.

BLUE TIT: Pick-cheese, *Bee-bird*, Betty-tit.

LONG-TAILED TIT: *Longtail Tittermouse*, *Featherpoke*, *Bottle-tom*, *Puddenpoke*.

GOLDCREST: *Redhead*, Herring-Spink (Fishermen).

BEARDED TIT: *Reed-Pheasant*.

SPOTTED FLYCATCHER : Wall-bird, *Beam-bird, Bee-bird.*

WILLOW WARBLER : *Oven-tit, Ovenbuilder, Ground-oven, Puddenpoke.*

GRASSHOPPER WARBLER : *Cricket bird, Scizzer-grinder, Razor-grinder.*

REED WARBLER : *Reed-bird, Reed-chuck, Reed-chinker.*

SEDGE WARBLER : *Reed-bird.*

WHITETHROAT : Hay-Jack, *Nettle-warbler, Nettle-creeper.*

MISTLE THRUSH : *Fulfer, Yellow Fulfer,* Fulfit.

SONG THRUSH : *Mavish.*

REDWING : *French Mavish, Stub Mavish.*

FIELDFARE : *Foreign Fulfer, French Fulfer, Dow Fulver, Felt,* Meslin Bird.

WHEATEAR : *White-rump, Shepherd-bird, Coney-sucker, Coney-chuck, Burrow-bird.*

WHINCHAT : *Furze-chat, Furze-chuck, Furze hacker.*

STONECHAT : *Furze-chat,* Furze-chuck, *Furze hacker.*

REDSTART : Fire-tail.

ROBIN : *Bob.*

NIGHTINGALE : *Barley-bird.*

HEDGE SPARROW : *Hatcher, Udger, Udgey, Hedge-Betty, Shuffle-wing, Hedgemonger, Hatchet.*

WREN : *Tom-tit,* Titty wren, *Doddy Wren, Stag.*

GREEN WOODPECKER : *Rain Bird.*

SAND MARTIN : *Pit Martin.*

SWIFT : *Devil, Devil-deen, Davelin.*

NIGHTJAR : Night-hawk, *Heave-jar, Big razor-grinder.*

LITTLE OWL : *Cat Owl, Dutch Owl.*

LONG-EARED OWL : *Horned Owl.*

SHORT-EARED OWL : *Marsh Owl, Woodcock Owl.*

BARN OWL : *White Owl, Billy-whit, Billy-wix, Gill-hooter, Madge.*

PEREGRINE : *Game-hawk.*

MERLIN : *Blue-hawk.*

KESTREL : Windhover.

MARSH HARRIER : *Moor Buzzard* (A.H.P.), *Marsh Hawk.*

MONTAGU'S HARRIER or HEN HARRIER : (male) *Blue-jacket, Grey Buzzard. Blue Harrier* (female), *Brown Harrier.*

SPOONBILL : Banjo-Bill.

GLOSSY IBIS : *Black Curlew* (Breydon).

HERON : Harnser.

BITTERN : *Bottle-bump, Buttle, Bittewren.*

BRENT GOOSE : *Scotch Goose.*

SHELD-DUCK : *Will Duck,* Burrow-Duck, Bergander, *Bargoose, Bayduck.*

NOTE—MALLARD and WIGEON are grouped as fowl or *right*-fowl as opposed to diving duck, which are grouped as *half* fowl, presumably owing to their lower commercial value. These terms are used mainly on the coast.

GARGARNEY : *Gargle Teal, Summer Teal, Cricket-teal.*

WIGEON : Smee, *Easterling.*

PINTAIL : *Longtailed Duck.*

SHOVELLER : *Spoon-bill-Duck, Shovel-bill,* Beck.

NOTE. The word *Poker* is used for any diving duck (Pochard, Tufted Scaup, Goldeye-etc).

POCHARD : *Red headed Poker*, Red-head, *Sandy Heads*, Dun-bird.

TUFTED DUCK : *Black and White Poker*, Golden-eye, *Arp*.

SCAUP : Greyback, *Blue-gill*.

GOLDENEYE : *Rattlewing*.

LONG TAILED DUCK : *Pheasant Duck*.

COMMON SCOTER : *Scooter*, Mussel-Duck, Black Duck.

GOOSANDER : Saw-bill.

RED-BREASTED MERGANSER : Sawyer.

SMEW : *Whim*, Weasel duck, White Nun.

GANNET : Gant or *Gent* (hard g).

LITTLE GREBE : *Deeve-dipper*, *Didopper*.

GREAT CRESTED GREBE : *Diver*.

ALL DIVERS : *Sea Divers*.

RED-THROATED DIVER : *Loon*, Sprat Loon.

GREAT NORTHERN DIVER : *Magatoon*.

WOODPIGEON : Dow.

STOCK DOVE : Blue Rock.

TURTLE DOVE : *Coo-coo-roo*.

MOOR-HEN : always Water hen.

CORNCRAKE : *Raffle Jack*.

WATER-RAIL : Rail.

SPOTTED CRAKE : *Spotted Rail*.

COOT : *Bald coot*, *Baldie-coot*.

OYSTER-CATCHER : *Dickie Bird*, Sea-pie.

RINGED PLOVER : Stone-runner, Ring-Dotterel, Stone hatcher.

GREY PLOVER : *Full-eyed Plover*, *Black-breast Plover*.

LAPWING : Peeweet, Hornpie, Flap-Jack, *Pert*.

TURNSTONE : *Tangle turner*.

DUNLIN : *Stint*.

Any small wader is called a Sandpiper.

COMMON SANDPIPER : *Little Stint*, Little Sandpiper, Summer Snipe, Shrieker.

WOOD SANDPIPER : Wood Tattler (W. A. Dutt).

GREEN SANDPIPER : *Woodpiper*, Black-Sandpiper, *Martin Snipe*.

SANDERLING : *Sand-Lark*.

REDSHANK : *Redleg*.

BLACK-WINGED STILT : Long-legged Plover (A.H.P.)

AVOCET : *Clinker*, *Shoe-horn*, Awl-bird.

GODWIT : *Pick*, *Scarnwell*, Yarwhelp.

WHIMBREL : Half-Curlew, May-bird.

COMMON SNIPE : *Summer Lamb*, *Air-goat*.

JACK SNIPE : *Half-Snipe*.

BLACK TERN : *Blue Darr*, *Darr-swallow*.

COMMON TERN : Darr, *Dipeere*, *Shrimp-picker*.

LESSER TERN : *Chit-pearl*.

GULLS (all species) : Mow.

ALL GREY GULLS : *Herring gulls*.

COMMON GULL : *Sprat-Mow*, Sea-Cob.

GREAT BLACK-BACKED GULL : Saddleback.

BLACK-HEADED GULL : Kittie, *Little Kittie*, *Peewit-gull*, *Skullcap Peewit*, *Scoulton Cob*, *Scoulton Gull*.

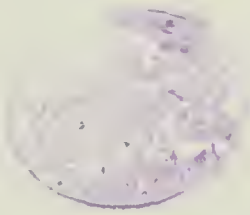
POMATORHINE SKUA OR RICHARDSON'S SKUA : Molberry, Boatswain, *Shyte-Hawk*.

RAZORBILL : *Wil-duck*.

GUILLEMOT : Wil-duck.

LITTLE AUK : *Sea-Dove*.

PUFFIN : *Sea-Parrot*.



[Helen Todd

Ringed Plover and Common Tern nesting within a few feet of each other at Scolt Head in June 1937

IX

WILD BIRD PROTECTION IN NORFOLK IN 1938

Report of the Committee

The committee has pleasure in presenting this, its eighteenth, report to its subscribers and would once again thank them for their help in providing the necessary funds to carry on the work of Bird Protection in Norfolk. It has to be remembered that each year a certain number of subscriptions lapse from deaths and other reasons, so that the honorary secretary is always grateful for suggestions for new sources of income.

There has been no change during the year in the personnel of the watchers, who are, in the order of their length of service, the following :—

Scolt Head Island—Charles Chestney, Dial House, Brancaster Staithe, King's Lynn.

Blakeney Point—William Eales, Morston, Blakeney.

Breydon Water—Walter Bulldeath, 35, North River Road Great Yarmouth.

Cley—William Bishop, Watchers Cottage, Cley.

These men are always ready to assist subscribers in seeing the bird-life of their respective areas but, to avoid disappointment, it is advisable to communicate with them beforehand.

SCOLT HEAD ISLAND

In spite of the fact that the area of the ternery at the west end of the island has been gradually reduced of late years by high tides, etc., and that a still further demolition took place as the result of the exceptional high tide and north-west gale of February 12th, the number of common terns' nests this year showed a considerable increase. The birds have spread their nesting sites to adjacent dunes.

Sandwich terns always arrive at Scolt Head later than they do at Salthouse, the first being seen this year on April 19th as against March 23rd at Salthouse, and the first egg laid on May 16th. It has been noticed for several years that the first eggs are nearly always destroyed, and it is supposed that these are pecked by the birds themselves, though they have never been seen to do this. After a few days they seem to

gain confidence and settle down and the egg-pecking ceases. The young Sandwich tern is hardier and more resistant to the weather than is the young common tern, and is fed largely on sand-eels, which are too bulky a diet for the chicks of the common tern when first hatched. The " white-bait "—young herrings—did not in-shore until very late in the season this year, and the result was that scores of young common terns died as day-old chicks. On the other hand, in spite of the unusually adverse weather conditions, but few of the Sandwich terns succumbed.

Again, the little terns did not suffer from food-shortage ; these birds would seem to live largely on shrimps and small marine larvæ.

It is not easy to identify an arctic tern among a large colony of common terns, but one pair nested on the ternery this year and was seen by several reliable observers. On the other hand, the call-note of the roseate tern is so distinctive that the ear can easily pick it up, and by this means of identification the watcher saw two of these flying over the ternery on May 26th. On June 1st they had nested and an egg was laid within a yard of last year's nest. This was incubated by the parents for four weeks, but proved to be infertile. One other roseate arrived and mated with a common tern, as happened in the previous two years. One egg was laid and hatched but the chick died at four days. Both parents were seen sitting on this egg.

We are indebted largely to the watcher's carefully kept diary for the following additional notes on the bird life of the Island during the past year.

During the winter months there were frequently to be seen one or two black-throated and red-throated divers in the harbour, where eleven red-breasted mergansers were nearly always to be found, besides various ducks, such as wigeon, golden-eye, tufted ducks, common scoters and, on one day, two velvet scoters.

From 50 to 100 brent geese remained in the harbour until the middle of April and, as they were never shot at, became very tame.

A flock of twenty-nine shore-larks wintered on the island, the last not leaving until April 28th—a late date. It is interest-

The Common Tern, with its black-tipped bill, beginning to display to the Roseate, with its all-black bill, on her nest

 [*S. Whitaker*

The Common Tern, with uplifted wings, in a later stage of display before the Roseate on her nest

ing to note that neither the two merlins nor the three hen-harriers that remained throughout the winter took toll of these, for the flock remained constant in number. The chief prey of these raptorials would seem to have been skylarks, meadow-pipits, and green-finches, of which there were large flocks, and an occasional snow-bunting.

Kestrels are commonly seen on the island and for the past four years one has roosted on the hut at night. Short-eared owls were occasionally flushed in the dunes, and on July 21st, one was found sitting on the top of a young pine in House Hills, but there is no evidence of their having nested on the island.

Occasionally quite unexpected birds are flushed in the dunes, such as a woodcock and two jack snipes on April 27th and a water-rail from the *Suæda* bushes on January 24th.

During the great gale of February 12th some razor-bills were blown on to the saltings and up into the fields above the village. A few bar-tailed godwits and turnstones remained throughout the winter.

There was a small passage of black terns to the westwards along the shore-line on April 20th and on May 4th.

On May 12th two cranes were seen by the watcher flying from east to west along the island ; they were calling loudly as they went along.

NESTS MARKED AND NUMBERED

Common tern	2470 nests
Sandwich tern	285 ,,
Little tern	144 ,,
Arctic tern	4 ,,
Roseate tern	1 ,,
Oyster-catchers	32 ,,
Ringed plover	31 ,,
Redshank	32 ,,
Lapwing	6 ,,

Many pairs of sheld-ducks nested in the rabbit holes in the dunes, and a few pairs of mallard hatched off. Every year black-headed gulls attempt to colonise at the east end of the island, but are not encouraged.

BLAKENEY POINT

As was the case with the Scolt Head ternery, a large proportion of the newly-hatched chicks of the common terns died

from shortage of food and boisterous weather. Sand-storms are their worst enemy.

The watcher, William Eales, made a census of the nests in the first week in July, with the following results :—

Common tern	1923	nests (2231 in 1937)
Little tern	57	,,
Arctic tern	1	,,
Ringed plover	136	,,
Oyster-catchers	21	,,
Redshanks	11	,,
Sheld-ducks	many	,,

It will be noted that the number of common terns' nests were 300 less than last year, but that they increased by 1,000 on the Scolt Head ternery.

In the first week of September the watcher had a close-up view of a white-winged black tern.

Mr. R. M. Goodman reports that he saw a Kentish plover on the point in September.

CLEY AND SALTHOUSE

November, 1937 to November, 1938.

The Trust's watcher at Cley is William Bishop, who keeps a daily record of his doings and observations, and it is chiefly from his diary that the following notes are extracted.

1937

November

On the 14th a few snow-buntings and four shore-larks were found on "Little Eye," Salthouse, and they remained for several weeks, but their numbers were not increased. On the 3rd there was a considerable east-to-west passage of grey-backed and carrion-crows. There was a flight of woodcock on the 16th, when four were seen flying over the marsh. On this day, also, a very large number of ducks came into the marshes. On the 18th, several pink-footed geese passed over and two days later five of this species and two white-fronts were resting on Salthouse Broad.

December

A month of light winds with a little snow on one day. With a N.N.E. wind there was another flight of woodcock on the

[*Helen Todd*

Oyster Catcher on nest in marram grass; an unusual situation

9th. During the previous weeks a hen-harrier had almost daily frequented the marsh and was joined by a second bird on the 19th. During the rest of the winter they were frequently seen quartering the marsh. Twelve pink-footed geese settled on the marsh on the 12th and 13th.

1938

January.

This was a boisterous month with gales from almost every quarter. Two bitterns made the marsh their headquarters during the winter and were frequently seen. The male started booming on March 21st. The harriers were seen to prey largely on greenfinches, which come to the marsh in big flocks in the winter to feed on reed seeds. On the 5th a short-eared owl was seen to kill a water-rail on the ground.

February. The Flood

Backed by a north-west gale of exceptional velocity the tide of the afternoon of the 12th caused extensive damage to the Norfolk coast. The last tide of comparable magnitude at Cley occurred on December 31st, 1921, when the concrete sea wall was extensively breached, allowing the sea to flood the marshes.

On the present occasion, in spite of its not being a spring tide—high-water was at 4.26 p.m. according to the tide-table—the sea rose very rapidly and swept the shingle ridge which was soon over-topped by the waves. The water rapidly covered the marshes to a depth of 5 feet and flooded the lower rooms of the houses in the street to a depth of 12 to 15 inches. The coast road between Cley and Salthouse was flooded to about 2 feet with waves breaking up on the south boundary hedge, and remained impassable to traffic for a week. The marsh remained under water until March 2nd, when the reed-cutters resumed work. Large numbers of voles, rats, moles, one bittern and a little auk were washed up on to the coast road and, least expected, a 3-lb. pike. Hen-harriers were seen on only two or three occasions after the 12th.

March

Two pairs of garganeys arrived on the marsh on the 19th and two more pairs two days later, but they only stayed about

ten days. For some three weeks after the flood there was no rain to wash out the salt, and the marsh seemed bereft of all bird life, except bitterns, which it is presumed fed on eels. One was heard booming on the 21st and two days later two were seen. Sandwich terns arrived earlier than usual; three came in from the sea on the 22nd and, after circling round, flew out to sea again. By the end of the month they had arrived in numbers.

April

A marsh-harrier was seen quartering the marsh on the 1st; on the next day three whooper swans passed to the west. Another north-west gale on the 3rd again flooded Cley marsh to about nine inches above normal, and Salthouse Broad to one foot. On the 9th two pairs of pintails were feeding on the marsh, and were seen on the flooded area of Salthouse Broad for some weeks. On the 1st a little gull was seen by Mr. C. W. G. Paulson on Salthouse Broad. On the 21st large flocks of wigeon—the return migration—were seen passing eastwards. Although Sandwich terns arrived earlier than usual, the first common tern was not seen until the 23rd, a month later. A ruff in full nuptial dress was feeding on Salthouse Broad on the 26th in the company of three bar-tailed godwits. A turtle dove was seen on the 30th.

May

The cold north and north-east winds of April gave place to southerly winds on the 11th, but it was not until the 18th that rain came and fell for twenty-six hours. This was the first good rain of the year. After this the grass on the marsh began to show sings of life again. On the 7th a north wind washed up several oiled guillemots and one fulmar on to the beach. It is not often, however, that oiled birds are found in any number on our north coast, there being very little shipping in the shallow waters of the Wash. In the Main Drain on the marsh there were at least a dozen common sandpipers on the 9th. The first brood of mallard were seen on the 12th, and the first brood of sheld-ducks three days later. Two avocets and a spoonbill arrived on Salthouse Broad on the 14th. Both of these species were to be found, on and off, either on the Broad or on the marsh throughout the summer.

On the 19th a peregrine came in from the sea and made a stoop at a bunch of dunlin ; on the same day Mr. G. Manser reported having seen four Manx shearwaters close in shore off Salthouse beach. We have no previous record of these birds having been seen in the spring off the Norfolk coast. On the evening of the 30th the watcher saw three bitterns on the wing on the marsh in front of his cottage and heard another booming on a distant part of the marsh. A fortnight later, on June 14th, he found the nest from which, on hearing his approach, the young disappeared into the reeds, leaving an addled egg in the nest.

June

The Sandwich terns on Salthouse Broad began to hatch on the 2nd. The number nesting on the small island on the Broad was even greater than last year ; so close were the eggs that it was impossible to count them—in the aggregate several hundred.

As already recorded in " British Birds " (July, 1938, p. 49) a pair of dunlins nested and hatched off on one of the grazing marshes at Salthouse. One of the young was found trodden upon by a horse's hoof and its identification verified by Mr. H. F. Witherby, and it is now preserved at the Norwich Castle Museum. This is the first record of the dunlin nesting in Norfolk. A black-tailed godwit was seen on the 14th ; of late years this species has visited Norfolk in increasing numbers, so that it may eventually nest once again with us. As showing the importance of controlling four-footed vermin it may be mentioned that on the morning of the 30th a stoat swam to a small island on the broad and killed sixteen adult common terns and five black-headed gulls by biting them in the back of the neck. During this month the watcher found nests of the following birds within a stone's throw of his hut on the east bank : stonechat, red-backed shrike, linnet, reed-warbler, meadow pipit, blackbird, song-thrush and turtle dove. Also, under the eaves of his cottage, which was built less than two years ago, there were eighteen house-martins' nests ; twelve on the north side, five on the east and one on the south.

July

A green sandpiper was feeding with two black-tailed godwits on a pool that had been recently cleared of reeds on the marsh. This pool is a favourite feeding-ground for waders. During this month several other black-tailed godwits were seen. A black tern was seen on the 14th, but very few of these birds passed through this year until the autumn migration.

August

In the third week of the month a wood-sandpiper and a dusky redshank were seen by Major Dawkes and the watcher. A few black terns passed through.

September

During this month an unusual number of waders passed through and the following of the more uncommon were identified by reliable observers :—ruff, greenshank, dusky redshank, green sandpiper, wood sandpiper, black-tailed godwit, little stint, curlew sandpiper. A spoonbill was feeding on Cley marsh on September 12th, when it left. This is probably the same bird that was seen passing west along Scolt Head Island the next day.

On the 24th, Mr. N. Tracy and Mr. Charles Gibbs had a prolonged and close-up view of a Kentish plover from the East Bank. They watched it for about an hour and had no doubt as to its identity.

October

This month was remarkable chiefly for the number of ruffs seen on the Cley marshes and for the big increase of grey plovers on Salthouse Broad.

On the 3rd, Bishop, the watcher, flushed twenty ruffs as he walked over the marsh and he counted the same number again on the 11th. Two of these were seen as late as November 16th.

A black tern, which appeared to stay on the marsh for several days, was last seen " hawking " over the big pool by the main drain on October 18th.

On the 3rd, Bishop flushed a dusky redshank and on the 4th Mr. Geoffrey Paulson and Mr. R. C. Homes identified an Iceland gull on Salthouse Broad.

A noticeable east to west migration began on the 15th and continued for several days. During this time flocks of lapwings, starlings and skylarks were passing almost continuously. The first grey crows were seen on the 18th and a large number of Continental blackbirds and big flocks of chaffinches came in on the 20th.

At the end of the month two hen harriers were seen " hawking " over the marsh.

BIRD NOTES. HORSEY

By Major A. Buxton

The winter of 1937–38 was a good one for duck, both surface feeders and divers, but from November onwards there was so much suitable country for them all over England owing to the heavy rains, that they were not forced to concentrate on waters such as the Broads. Probably owing to hard weather in Scotland in the autumn there were numbers of fresh arrivals in October and November, particularly of mallard, and Horsey Mere filled up with divers rather earlier than usual. I have never seen, for instance, so many goldeneye as in November, 1937, when there were probably up to 200 on the Mere. Late in November and early in December there were about 1,500 diving ducks, mainly pochard and tufted, using the Mere in the day time and, after a pause, large quantities again in January. In the previous season a great passage of tufted occurred at the beginning of February, but this was not repeated and by the end of January the duck population had diminished.

After the sea-flooding in February and in March a quantity of wigeon, which in normal years would have rested out at sea, sat about in large companies on the sea water in the marshes and probably fed on the unsalted area inland. There was no great invasion of grebes, as occurred in the previous season, and very few coot throughout the winter.

The sea floods have been disastrous to bird life at Horsey, but since I deal with this question in an account of the effects of the floods, these notes shall be confined mainly to the few birds which seemed more or less unaffected.

So far as I can judge, there was only one bittern's nest on Horsey, but it produced at least two young birds, for I found

them at the end of June in a sedge marsh. They must have been hatched remarkably early, for when I saw them, with beaks pointing straight to the sky and absolutely motionless, although sedge leaves were tickling their eyes, they looked so large that for the moment I thought the first one discovered was an old bird. After being stirred up with a stick, this individual made a savage attack and shot out his mane like a lion. His companion never even winked an eye during the whole time that we were in his presence. The bird that made the attack subsequently walked slowly off trailing first one wing and then the other behind him. It looked like a bit of matting being pulled through the sedge. I was told subsequently that their parents had discovered a place in Waxham parish where frogs were obtainable. It was clever of them to discover that, for there was practically not a frog in Horsey where they normally swarm. These young birds showed no sign of powder on their heads which looked quite black, like a stuffed bittern's, and I presume that young bitterns do not start powder puffing until they " come out " and can catch an eel on their own, when the powder would no doubt be essential to protect their feathers from the grease of a struggling eel.

A pair of marsh-harriers appeared at the usual time, and the hen, which looked like a young bird and may well have been the individual that failed to lay last year, produced five eggs, on which she sat for about six weeks, but none of the eggs hatched. The cock, a finely marked bird, looked like the occupant of that territory last year. I can give no explanation of the failure to hatch. Since there was nothing to catch at Horsey, the cock hunted further inland and the kills I saw were chiefly leverets and moles. There were no spare cocks about and only two passing Montagu harriers were seen throughout the season.

The bearded tits that were foolish enough to remain wandered about from place to place sometimes in parties, as though it were winter, sometimes in pairs, looking for food and nesting sites. Only one nest was found but the eggs never hatched. There were plenty of bearded tits inhabiting their usual quarters in a reed bed in the winter. Have they found a safe retreat elsewhere or are they dead ?

Turtle doves seemed quite indifferent to the changed aspect of the marshes. No doubt they found their food outside the flooded area, and it does not take a turtle dove long to cover two or three miles. Some of them nested in young silver birch that for some reason resisted the effects of the salt, but others seemed quite happy on the bare branches of a dead bush. I came to close quarters with one pair and learnt something about them. They are extremely pretty birds, but rather dull. Owing to a hint that they were shy subjects for photography, great precautions were taken to avoid upsetting their nerves, but before the hide erected at 7 feet from their nest was completed, the sitting bird had ceased to take any alarm at the proceedings: the platform was erected, the sides and roof were put on, and nails driven in with a hammer without causing her to leave the nest. Practically all the work intended to deceive and allay suspicions, was done in front of the subject's eyes, and subsequently there was no need of the usual precaution of a companion to walk away from the hide, which could be entered or evacuated without in any way disturbing the bird. The two young were quaint little beasts, covered with yellow down and with black faces. Just before they could move about in the nest they were inclined to show fight when approached and pecked at the hand, but as their feathers grew they became more dovelike and docile. The sitting parents assumed a very round puffed-out shape when perfectly at ease, but squatted flat on the nest if suspicious. The feeding of the young was performed in the same way as that of a wood pigeon, and when the young birds could stand and stretch up, the performance looked like three people working a pump, the pump being the parent's throat. Both the young stretched their necks to the fullest extent and inserted their bills in their parent's mouth. The parent then worked her neck up and down in a laboured and jerky motion, which was of course transmitted to the necks of the young. It was a grotesque performance and looked an uncomfortable method of serving and eating a meal. On one occasion the parent sat for one and a half hours on a bough by the nest, before coming on to feed, presumably to allow the contents of her crop to reach the proper consistency. At other times she would arrive with a noisy bluster and produce the food

at once. The young were fed long after they had left the nest, on the paling of a look-out in a neighbouring tree, which provided a solid perch for their feet.

I am told that pigeons do not object to drinking salt water. If this be true it may account for the numbers of woodpigeons stock doves and turtle doves, which bred in the flooded area. Except after rain, there was practically no fresh-water to drink, and the small pool in the garden was the common resort of all its inhabitants. The young pigeons and turtle doves bred in the marshes could not, however, have been able to reach any fresh-water. They must have resorted to salt-water or been given a drink by their parents.

There were a very few sedge-warblers scattered about, far more reed-warblers, no grasshopper warblers, no blackcaps, and practically no whitethroats, except on the oasis that escaped the flood. A few cock willow-wrens hung about for a time, but I believe there was only one hen, who found a possible nesting place in a small group of silver birch that for some reason thrived in the middle of a reed marsh. The only compensation in the matter of warblers was a large collection of garden-warblers round the house. There they sang their heads off, largely I believe because there were not enough hens to go round, for few of the latter stayed.

There is little to relate about waders, for apart from the usual passage of ruffs and reeves, spotted redshanks, greenshanks, etc., which fed on the salt pools as the water receded, there were no shallow pools of fresh-water to attract such birds in the summer. A pair of spoonbills were seen, but they did not stop.

The curlew migration began as usual about June 15th and continued to the first week of July. This movement, which is made by an enormous number of birds, has always puzzled me. The line of flight is roughly from east to west and the birds are clearly coming from the continent, but why at that time of year? It is much too early for a movement of curlew breeding either in this country or in western Europe, for in June such birds are still attending to their young in their nesting haunts. They could not move so soon. Many of them at least are not young birds for they constantly make the spring call. If curlew do not breed in their first season they

may be immature birds, but I doubt it. I think they must be coming from some place, probably far to the east, where curlew breed earlier than in western Europe, and that the object of their journey is to reach the extensive mud flats laid bare by the big tides of the Atlantic. Whatever the cause, this January to July movement of curlew is odd at a time when so little movement is going on among other birds. I have often heard curlew passing over London, particularly at night in early July.

How long is this place going to be a desert, for birds as well as plants and insects? There will, I think, be an increase of reed, for its competitors, rush cheat and sedge, have received a blow from which they will take time to recover. Most of the birds, which like reed, like something else underneath it; moreover, there are no fish and practically no insects and no earth worms. Wire worms have survived.: they would. With such a dearth of food and covert, recovery and recolonization will probably be very slow.

We always see, or hear, a few spotted crake in the autumn, but in 1938, at the end of October, there was quite an invasion. There were crakes all round the edge of the mere, and one was heard having a violent altercation with a water-rail. On November 5th I heard about a dozen, six of them all close together moving about in the dead gladden. The commonest note reminds me of an agricultural instrument with a slight "creak." The brake of a motor car sometimes makes a similar noise when suddenly applied. There is first a single note and then a series of creaks. When one bird creaks, they all creak, and during the last hour before sunset they were seldom silent for long. I do not know what they were finding to eat, but in dykes and along the edges of the mere there were great numbers of shrimps.

NOTES FROM HICKLING, 1938

By Jim Vincent

The storm of the 10th, 11th and 12th of February, 1938, which burst the sea defences on the night of the 12th, created a vast flooded area involving Horsey, Somerton, Hickling, Potter Heigham, Waxham and Palling, such as had never before been witnessed by anyone living.

I had often pondered over in my mind what effect a large flooded area would have upon the neighbourhood and its bird population, especially on the wildfowl and waders. Now it had come and I was almost frightened at its magnitude. At first, the struggle for personal safety and the need for stemming back the flood waters dominated one's activities rather than watching its effects upon the birds, but from early days it was obvious that the birds did not relish the sea water which was too deep and rough for wildfowl and waders. The wholesale destruction of coarse fish went on steadily to the end of March, by which time they were all wiped out from Horsey Mere, Somerton and Martham Broads, Heigham Sounds and Hickling Broad.

Before passing direct to the birds, I should note that after eight months the vegetation, herbage, bushes and trees have all suffered sadly in the affected areas, but at this stage one cannot determine what is dead or what may be delayed growth ; 1939 will prove it. The vast beds of lesser reed mace around these waters looks absolutely dead, also the larvæ in the stems must have been killed. This upset the bearded tits sadly, though they made a brave effort to adapt themselves to the changed conditions.

The wholesale destruction of worms, grubs, insects and vegetable food had the most disastrous effect upon the mallard, shoveler, garganey and common teal, coot, moorhens, water-rail, Lapwings, snipe and redshanks, and though I found a number of nests of all of these (except garganey and common teal) yet I could find no evidence that any of the species named succeeded in rearing a single youngster ; they all perished within a few days of hatching. I found nests of great-crested grebes, but not a single youngster was hatched out or seen. It sadly affected, also, the wild marsh pheasants which were fewer on October 1st than on April 1st.

The smaller species of birds such as bearded tits, reed-bunting, sedge-warblers, reed-warblers and meadow-pipits, all had small clutches of eggs, and I think the salinity of the water was the cause of the many infertile eggs of all species.

Bitterns were definitely fewer, and absent on areas where they have bred or boomed for the past twenty years. There were five booming males on the Hickling area, but we found

[*Helen Todd*

Male Bearded Tit at nest

only two nests where the young were reared successfully upon eels or small fry from the dykes only slightly affected with salt. This species is now so well established that I have no fears for its future.

Bearded tits.—A local migration of this species occurs at the end of March from the Yare to swell the number of those which have wintered with us, and by March 28th a number had arrived. On April 1st I found the first nest and egg. As time went on one could see they were all in confusion over the change which had taken place. Instead of clinging to their old areas they roamed the open sedgy marshes, and gathered food from places where I have never found them before. A dozen nests were found up to September 11th without searching for them, and there was evidence of a good number of young ones which reached maturity.

Marsh-harrier.—A pair bred and six eggs were laid, but only one youngster was hatched. This reached maturity and is still here on November 25th. Mr. Tracy made a grant of £5, from the Association of Bird Watchers and Wardens, to help in protecting this pair by providing Watchers. These birds had great difficulty in procuring food.

Montagu's harrier.—For the first season within my memory I did not see a single bird.

Garganey teal.—These hated the salt water, as did also the common teal, and for weeks not a bird of either species was to be seen.

It was amazing how quickly upon arriving, the various species sensed the change and the food shortage and cleared off. Some of the rarer birds seen on migration were the following :—

Water-pipit.—I saw this on March 24th, and either the same bird or another one on the following day, running along the flotsam at Somerton.

Roller.—This was seen by a farmer and his daughter on a meadow behind their house. It was flying up and down to the branches of a small oak tree. I was informed of it and had an excellent view of the bird perching and in flight, for over an hour.

Spoonbill.—I do not remember seeing more of this species during the spring than I saw this year. It may have been due to the vast number of shrimps which abound here. I

saw six spoonbills on 15th May, one on the 18th, five on the 19th, one on the 27th, three on June 7th and two on August 10th.

Black terns.—I saw only one solitary bird on May 22nd.

Gull-billed tern.—Mr. E. Piggin and I saw one on two occasions on June 14th within fifteen yards.

Spotted redshanks.—A fine adult bird was here on May 27th.

Temminck stint.—One was seen here on May 27th and 28th.

Rough-legged buzzard.—Seen here on May 28th and 30th On the latter date it was chased off by the male marsh-harrier.

Woodlark.—Mr. Ian Thomson and I saw a bird of this species here on July 2nd.

Waders.—During August and September there were many more waders than usual. They included spotted redshanks, greenshanks, ruffs and reeves, common sandpipers, a Temminck stint, dunlin, ringed plovers and green-and wood-sandpipers.

Great grey shrike.—One was seen by Mr. Ian Thomson and myself on a low thorn bush on October 16th.

Grey phalarope.—One was here for three days from October 31st.

A hybrid gadwall American wigeon was killed here when flighting on November 21st. It was examined and certified as such by Mr. Hugh Wormald.

Starch Grass.

The effects of the salt water inundation of the Hickling-Horsea area as so graphically described by Jim Vincent apply equally to the Trusts' twenty acres of reed-marsh known as Starch Grass. It is believed that one pair of Bitterns nested here this year.

BREYDON WATER

The committee again employed Walter Bulldeath as watcher on this estuary from April to the end of the first week in August. He lives on the Trust's houseboat moored in the middle of the estuary, from which he commands a view of the whole area. The estuary is a feeding-ground during the spring migration for a large number of waders and, years ago, any rarities amongst them were eagerly sought by local gunners,

but of late years this illicit shooting has almost died out. Spoonbills visit the estuary irregularly throughout the summer.

Mr. Robin Harrison sends the following records :—

There were fewer short-eared owls nesting in the district this year ; he found one nest with young on June 15th. On June 19th he saw the first brood of young sheld-ducks, and these nested in their usual numbers. The number of lapwings and redshanks breeding in the district appears to be increasing.

During the Spring migration he reports unusual numbers of spoonbills on Breydon, including nine on May 12th which remained for several days.

The number and variety of waders passing through was considerable, on the 16th of May he counted forty-two grey plovers in full nuptial plumage.

The Autumn migration was disappointing, the most interesting note being of four ruffs on 22nd of September, and two black-tailed godwits on October 3rd.

MISCELLANEOUS NOTES

The extensive flooding by the sea of the Horsey–Hickling area of Broadland on February 12th, an inundation that lasted for several weeks, caused such a mortality amongst the fauna and flora of the district as can only be measured by time. One of the obvious results, however, was a decrease in the number of nesting bitterns in the area, and an extension of their range into other parts of Norfolk, and into Suffolk. Mr. Charles Dallas reports the almost certain nesting of two pairs between Acle and Great Yarmouth, and the writer was told of two nests that hatched off in another part of this district. There was also a nest at Cley, mentioned elsewhere in this report, and Mr. T. J. Wallace reports having flushed a bittern from its nest of four eggs in East Suffolk.

The frequency with which the bird was either seen or heard booming in other districts suggests that some of these also contained nests.

During the last two years there has been a noticeable decrease in the number of cuckoos visiting Norfolk, and during the past season there was a great scarcity of these birds.

Mr. Tracey sends the following notes from his wood sanctuary at South Wootton.

On April 10th he saw a pair of bramblings on a silver birch, the male singing a song which somewhat resembled the first part of that of the chaffinch. A week previously he had seen a flock of several hundred of these birds feeding on silver birch catkins. This is an interesting record, as comparatively few bramblings were to be seen in Norfolk last winter.

He had greater—and lesser—spotted woodpeckers nesting in the same tree, the former being eventually ousted by starlings. The bough containing the nest of the lesser spotted snapped off in a gale, leaving most of the hole exposed, but the young had hatched and the parents continued to feed them.

There were six or seven pairs of common redstarts in the wood and several nests were found.

On September 3rd he saw a male crossbill feeding two young at Sandringham with seeds that it extracted from a cone. The mandibles of the young had only just begun to cross, from which he inferred that they were about three weeks old. At that date there were numbers of crossbills in the district, mostly in pairs and family parties. Near the end of the month he saw a male perched on the top of a Corsican pine in full song, and describes the song as follows :—" It started off with the usual song which sounds rather like that of a Great Tit, then for about five minutes it repeated a very pure sweet whistle ; the song was then very like that of the Canary and was followed by a good imitation of a Wood-lark's song. The next day a wood-lark was singing for a quarter of an hour over my wood."

A great grey shrike was seen at close quarters by the Hon. Mrs. W. H. Lascelles on Salthouse heath on January 17th ; and on June 7th another visited Captain Gibson's garden at Roughton.

Three whooper swans were seen on February 6th on one of the West Norfolk meres, where they remained for several weeks.

On April 4th Mr. W. Everington found a large flock of golden plover, estimated at from 200 to 300, on one of his ploughed fields at Castleacre birds obviously on their northward migration.

A common tern ringed on Blakeney Point in July, 1933, was found there, dead, by the watcher during this summer.

On October 27th Colonel and Mrs. Meiklejohn identified a snowy owl at Gunton. It flew across a stubble field and settled on the corner of a haystack, allowing them to approach within a few yards of it. Later it flew off into the woods of Gunton Park.

Little Eye Bungalow

It will be remembered that when Mr. Garnett left the county last year, the Trust purchased from him the hill known as "Little Eye" at Salthouse. The bungalow on the hill has been overhauled, and a new heating and cooking apparatus, bedsteads and bedding installed. It commands the best view to be had of Salthouse Broad. For terms of its hire, applications should be made to the Honorary Secretary, 31, Surrey Street, Norwich.

Signed (on behalf of the Norfolk W.B.P. Committee),

Sydney H. Long, *Honorary Secretary.*

X

THE HERRING FISHERY, 1938

By The Editor

It has been a thoroughly bad herring season in regard to quality catch and price. The following table gives the weekly landings at Yarmouth and Lowestoft in 1938, as compared with 1937.

	Yarmouth.		Lowestoft.	
	1938	1937	1938	1937
Date	crans	crans	crans	crans
Oct. 8 ...	5,882	19,256	2,888	10,383
,, 15 ...	44,050	28,927	22,567	26,861
,, 22 ...	56,820	46,594	33,896	31,385
,, 29 ...	55,995	77,567	32,099	45,521
Nov. 5 ...	46,399	83,962	40,798	45,430
,, 12 ...	50,794	33,515	40,943	33,502
,, 19 ...	17,028	31,352	17,347	30,480
,, 26 ...	9,477	20,562	10,723	19,747
Dec. 3 ...	3,478	7,968	6,703	16,270
,, 10 ...			6,039	19,810
,, 17 ...			4,936	7,294

The landings at Yarmouth totalled 300,463 crans valued at £293,000 (371,162 crans valued at £468,000 in 1937), those at Lowestoft totalled 219,756 crans valued at £247,719 (290,785 crans valued at £364,355 in 1937).

There were many small herrings in the shoals in October, at the moment when continental buyers were looking for larger fish, which reacted on the price. The normal price of fresh herrings was between 28s. 6d. and 24s. per cran, but during a shortage of supply it rose to 88s. 6d. ; the lowest price paid was 10s. per cran. There were 110 less boats employed at Yarmouth than in 1937. The forecast issued by the Ministry of Fisheries in September that herrings would be small, and that there would be a large proportion of 4-year old fish was verified during the season.

There were ten less Scottish curers and over 500 less girl workers employed than last year. The highest gross earnings of a Yarmouth drifter were £1,700, the lowest £650. One Scottish boat earned £1,350, the average over the Scottish

fleet being £180 less than last year. The highest gross earnings of a Lowestoft drifter were about £2,500, the lowest about £500. The average earnings of Lowestoft drifters were £1,000, nearly £500 less than last year. The weather was fair, but there were a few strong gales and unfortunately three men were swept overboard and drowned.

An appeal was made to the Ministry for a grant of 25 per cent. of drifters' running expenses, which would have totalled £155,000, but it was refused on the ground that the Government's policy had been to grant loans for reconditioning vessels and building new ones. The Herring Industry Board issued stricter decrees than ever before concerning the number of nets that might be shot, the number of boats that could put to sea, and the amount of herrings that could be caught; landing of overday herrings was prohibited. These restrictions, made to avoid a glut, caused a good deal of resentment. The Scottish girl workers persuaded Scottish curers not to accept Sunday-caught fish since their fishermen do not fish on Sundays. The curers had to accept the situation. The Herring Catchers Association, which represents practically the whole of the English Herring fleet, have refused to co-operate with the New Herring Industry Board.

The largest catches were made, as is usually the case, at periods of full moon. On October 18th 360 boats landed 19,130 crans, and on November 18th, 183 drifters landed 15,064 crans. The best weeks were those ending October 22nd, when 56,820 crans were landed, the following week and that ending November 12th. The top shot of the season was made by the Lowestoft drifter *Hosanna*, winner of the Prunier trophy, with the Fraserburgh drifter *Allockby*, runner-up.

Most of the Scottish fleet had left by the end of November. 58,239 cases of fresh herrings against 57,000 cases last year, were exported, about four-fifths going to Germany and one-fifth to Poland. Russia, which has been a large customer in the past, took nothing at all. Cured herrings have been in steady demand at Baltic Rhine and Danube ports, and Palestine and Canada have also taken some. By December 10th, 162,000 barrels of cured fish had left for foreign ports.

The Herring Board was strongly criticized for its failure to find fresh markets. It replied that its attempts to do so had

met with no success and that it considered part of the present fleets redundant. An inhabitant of East Norfolk refuses to accept this answer, when he finds a difficulty in having fresh herrings delivered within twelve miles of Yarmouth, and can seldom obtain them for breakfast, as a variation to lemon and turbot, in the restaurant cars leaving Yarmouth and Norwich during the fishing season. It is suggested that the Fishery Board might make further explorations both near home and further afield. My best thanks are due to the "Eastern Daily Press" for the information contained in this report.

XI

NORFOLK COUNTY LIST OF FUNGI.

(Continued from Vol. XIV, Part III, p. 300).

By G. J. Cooke

ABBREVIATIONS.

V.C. = very common
C. = common
F.C. = fairly common
N.I. = not infrequent
U. = uncommon
R. = rare
S. = sporadic
Sow. = Sowerby
R.W. = Richard Ward
K.T. = Kirby Trimmer
C.B.P. = C. B. Plowright
M.C.C. = M. C. Cooke
B.M.S. = British Mycological Society
E.A.E. = E. A. Ellis
G.J.C. = G. J. Cooke

In the case of commoner species, only a few representative localities are given ; fuller details are given in the card index available for the use of students in the Norfolk Room of Norwich Castle Museum.

The numbers given before species names are those of Carleton Rea's " British Basidiomycetæ."

HYMENOMYCETES

92. *Pluteus cervinus* (Schæff.) Fr.—F.C. " Not very common " (C.B.P., 1872) ; Felbrigg Great Wood, Northrepps, Westwick, Horstead, Catton, Sprowston, Stratton Strawless, Bluestone Wood at Heydon, Honingham (very abundant among sawdust heaps and stumps, October, 1937 and 1938), Trowse (B.M.S.), Wheatfen, Breckland (E.A.E.). Var. *bullii* Berk.—Horstead, Earlham Park (at base of oak) and East Carleton.

93. *P. eximius* Saund. & Sm.—U.

95. *P. petasatus* (Fr.) Karst.—U. (C.B.P. in 1884 list).

97. *P. umbrosus* (Pers.) Fr.—U. Heacham Hall, 13/9/1896 and Little Massingham Belt, 29/8/1900 (C.B.P.).

101. *P. salicinus* (Pers.) Fr.—U. North Wootton (C.B.P., 1884 list), South Wootton (C.B.P., 1889 list) ; Westwick, 3/10/1934 (B.M.S.) ; Wheatfen ; Mickle Mere, Wretham, 7/9/1935 (G.J.C.). Var. *beryllus* (Pers.) Fr.—Felbrigg Wood, 24/8/1913 (C. Rea).

102. *P. hispidulus* Fr.—U. : on birch sticks at Attlebridge, 11/5/1932 ; Framingham Woods, 28/9/1933.

103. *P. pellitus* (Pers.) Fr.—U. : Plumstead Road Woods, Thorpe, 5/10/1934 (B.M.S.).

104. *P. nanus* (Pers.) Fr.—U. : Reffley, 9/1872 (C.B.P.) ; Wheatfen 30/5/1936 (E.A.E. and G.J.C.). Var. *lutescens* Fr.—(C.B.P. in 1884 list) ; Keswick, 29/9/1922 ; Plumstead Road, Thorpe, 5/10/1934 (B.M.S.).

108. *P. leoninus* (Schæff.) Fr.—R. : Boal Quay, Lynn, 2/8/1865 (Miss Lowe in C.B.P.'s list of 1872).

110. *P. chrysophæus* (Schæff.) Fr.—(C.B.P. in 1884 list).

111. *P. phlebophorus* (Ditm.) Fr.—(C.B.P. in 1884 list).

115. *Pluteolus aleuriatus* Fr.—Felbrigg Wood, 24/8/1913 (C. Rea).

118. *Lepiota procera* (Scop.) Fr.—" Not very common near Lynn, Thuxton, Sparham, etc. Mr. Amyot found it plentifully in October, 1859, but has only seen it once since . . ." (C.B.P., 1872). Common throughout East Norfolk pastures ; abundant in the Thetford district, September, 1916, when very large specimens were found. Localities include Felbrigg, West Runton, Mundesley, Westwick, Stratton Strawless (B.M.S.), Honingham Brecks, Colney and Framingham.

119. *L. prominens* Fr.—Colney Park, 3/10/1913 and Ringland, 18/11/1914.

120. *L. rhacodes* (Vitt.) Fr.—" Far more abundant than the preceding," i.e., *L. procera* (C.B.P., 1872). F.C. ; localities include Felbrigg Great Wood, Westwick, Stratton Strawless, Attlebridge, Drayton, Dunston, Framingham and Strumpshaw.

121. *L. puellaris* Rea—R. : one found at the edge of a pine wood, near open ground with scattered oaks, at Drayton Brecks, 18/11/1938 (Mrs. Cooke).

123. *L. excoriata* (Schæff.) Fr.—N.I. : Eaton, August and September, 1920 and November, 1928 ; West Runton (J. E. Sainty) ; North Denes at Gt. Yarmouth (E.A.E.) and Drayton Brecks.

124. *L. gracilenta* (Krombh.) Fr.—Wheatfen Broad, 17/5/1937 (E.A.E.) ; Colney, 30/9/1937 and Honingham, 25/10/1938.

125. *L. mastoidea* Fr.—R. : Leziate, 24/9/1904 (C.B.P.).

127. *L. acutesquamosa* (Weinm.) Fr.—U. : recorded by C.B.P. in 1884 list. Appeared in a garden at N. Heigham, Norwich, annually in September and October, 1910–1914 (G.J.C.).

128. *L. Friesii* (Lasch.) Fr.—U. : C.B.P. in 1884 list. East Runton, 30/9/1932 ; on a lumber ground at Carrow, 4/11/1933 (E.A.E.) ; Holt, 27/8/1936 ; Eaton, under a privet fence, 7/8/1936 and again in October, 1938.

129. *L. hispida* (Lasch.) Fr.—R. : " Hare Wood, Docking, 23/9/1896 (C.B.P.) ; Felthorpe Woods, 8/10/1920.

130. *L. Badhami* B. & Br.—R. : " North Wootton, on a hedge bank, October 30th, 1871. The specimens found are figured in Mycological Illustrations, t.35 " (C.B.P.).

131. *L. meleagris* (Sow.) Fr.—S. : " King's Lynn, in greenhouses " (M.C.C.) ; Brandon, 20/10/1900 (C.B.P.).

134. *L. clypeolaria* (Bull.) Fr.—U. : Salhouse, 7/10/1848 (R.W.) ; Honingham Brecks, 9/11/1937 and Drayton Brecks, 7/1/1938 and 15/10/1938. Plowright recorded *L. metulæspora* B. & Br. as a Norfolk species in his 1884 list, but records of this as British are now regarded as erroneous and referred to *L. clypeolaria*.

137. *L. alba* (Bres.) Sacc.—U. : North Wootton Heath, 21/8/1902 ; Sandringham, 25/10/1902 and Castle Rising Heath the following day (all C.B.P.) ; King's Lynn, 25/10/1902 (C. Rea) ; Mousehold and Honingham Brecks, November, 1937.

141. *L. felina* (Pers.) Fr.—U. : " Middleton and North Wootton " (C.B.P. in 1889 list) ; Northrepps and West Runton, 2/10/1934 (B.M.S.) ; Felbrigg Great Wood, 25/9/1938.

144. *L. cristata* (A. & S.) Fr.—C. : " Abundant " (C.B.P. in 1872 list). Localities include Sandringham, West Runton, Felbrigg, Westwick, Horstead, Stratton Strawless, Bluestone Wood at Heydon, Attlebridge, Drayton, Colney, Earlham, Bramerton Common and Pedham.

149. *L. holosericea* Fr.—U. : Happisburgh, 3/10/1936 (G.J.C.) ; Holkham Park, 19/8/1938 (E. W. Clarke).

150. *L. erminea* Fr.—R. : " This plant grew in Dr. John Lowe's fernery at Lynn, in September, 1871 " ; Castle Rising Heath, 25/10/1896 (C.B.P.). Sprowston Wood, 28/9/1933 (G. J. C.) and Earlham Green Lane, 25/10/1938 (M. B. Ellis).

152. *L. cepæstipes* (Sow.) Fr.—S. : Recorded by C.B.P. in his 1884 list.

157. *L. granulosa* (Batsch.) Fr.—C. : " Common " (C.B.P., 1872). Localities include Northrepps, Westwick, Mousehold, St. Faith's Common, Stratton Strawless (at the same spot, 25/10/1910, 26/9/1916 and 29/10/1924), Holt (C. P. Petch), Drayton, Honingham, Ringland, Costessey and Wheatfen Broad.

158. *L. amianthina* (Scop.) Fr.—N.I. : Mousehold Heath, 17/10/1927, also at Westwick, Drayton Brecks and Dunston Common.

159. *L. cinnabarina* (A. & S.) Fr.—R. : Recorded by C.B.P. in his 1884 list. Drayton Druery, 4/11/1932.

160. *L. carcharias* (Pers.) Fr.—N.I. : C.B.P. in 1884 list. In one spot at Drayton Druery in Novembers of 1914 and 1919 and in August there for several years ; also at Westwick, Sprowston Wood, Mousehold, Ringland Hills and Honingham.

163. *L. hæmatosperma* (Bull.) Bond.—R. : " Rising, 5th November, 1870, on chips in a carpenter's yard " (recorded by C.B.P. in 1872 list as Agaricus echinatus Roth, and later, without locality, as Psaliota echinatus (Roth.) in 1884 list).

164. *L. polysticta* Berk.—R. : C.B.P. list, 1884.

166. *L. sistrata* Fr.—U. : Brandon, 20/10/1900 (C.B.P.) ; Runton, 8/10/1932 ; Westwick, 16/10/1935 and Bluestone Wood at Heydon, 2/10/1937.

167. *L. seminuda* (Lasch.) Fr.—R. : C.B.P. list, 1884. Sheringham Park, 15/9/1932.

168. *L. Bucknallii* B. & Br.—R. : Hare Wood, Docking, 23/9/1896 (C.B.P.).

173. *L. medullata* Fr.—R. : C.B.P. list, 1884.

179. *L. Georginæ* W. G. Sm.—R. : Grimston, September, 1900 (C.B.P.) ; pine wood near Morston, 17/8/1915 (C. Rea).

**L. lævigata lange*—R. : Drayton Brecks, 5/11/1938.

†*L. echinella* Quél. & Bern.—U. : Honingham, 8/9/1934 (G.J.C.), Wheatfen Broad and Plumstead Road woods, Thorpe in October, 1934 (B.M.S.), in a spruce wood at Framingham, 29/11/1934, 11/10/1935 and 7/8/1936 (G.J.C.) ; Ashby St. Mary, 1938 (E.A.E.).

185. *Psaliota Elvensis* B. & Br.—R. : Colney, 2/10/1929.

187. *P. arvensis* (Schæff.) Fr.—V.C. : " Much more abundant than *P. campestris* " (C.B.P., 1872). More plentiful in the marsh districts of East Norfolk than in upland areas. Localities include Holkham marshes, August, 1910 ; Westwick, Horning, Holt, Heydon, Great Melton, Hethersett, East Carleton, Ketteringham, Wheatfen Broad. Var. *purpurascens* Cke. was found at Stratton Strawless, 4/10/1934 (B.M.S.).

188. *P. xanthoderma* Genev.—C. : Probably observed by Plowright as *P. arvensis* in part when he remarks " the younger plants change to yellow when cut or bruised " (C.B.P., 1872). Localities include Stratton Strawless (B.M.S.), Runton, Haynford, Horning (C. J. Brooks), Lion Wood at Thorpe, Hethersett, Stoke Holy Cross, Earlham, Arminghall, Trowse, Framingham and Wheatfen Broad. Var. *lepiotoides* R. Maire has been found rarely ; M.C.C. recorded it as *P. cretacea* Fr. from King's Lynn, February, 1883 and I have seen it at Beech Grove, Drayton, 11/11/1914 and Bawburgh Hangings, 26/7/1936 and 25/10/1938.

189. *P. flavescens* Gillet.—U. : Stratton Strawless, 3/10/1934 (B.M.S.) and Runton cliffs, 28/9/1932.

190. *P. perrara* Schulz.—R. : Attlebridge, 2/10/1912.

192. *P. campestris* (L.) Fr.—C. in various forms : " Common all over the county " (C.B.P., 1872) ; in a pasture, Earlham (K.T.). Often under scattered trees in parks and by roadsides. The following marked varieties have been noticed :—var. *rufescens* Berk. " occasionally around Lynn " (C.B.P., 1872) ; var. *exannulata* Cke. at Mattishall (M.C.C., Cke. Ill, 528 t. 546), and Felbrigg Park, 24/9/1938, var. *hortensis* Cke. at Earlham Park, 22/11/1935 and subsequently at Bawburgh and Felbrigg Park.

193. *P. sylvicola* (Vitt.) Fr.—C. : Localities include Northrepps, Stratton Strawless, Felbrigg, Westwick, Skeyton, Stody Wood, Norwich Cemetery, Taverham, Drayton, Colney, Ketteringham, Cringleford, Bawburgh, Framingham, Trowse, Arminghall, Ashby St. Mary and Wheatfen Broad.

196. *P. sylvatica* (Schæff.) Fr.—N.1. : recorded by C.B.P. in 1884 list ; found usually in pine and spruce woods, e.g. at Framingham ; Holkham Meals, September, 1932.

197. *P. hæmorrhoidaria* Kalchbr.—F.C. : in woods, mostly coniferous. Localities include Horsford, 12/10/1910, Felthorpe, Drayton pine wood, Colney, Earlham, Ketteringham, Keswick, Eaton and Framingham Chase.

200. *P. comtula* Fr.—C. : Localities include Westwick, 4/10/1934 (B.M.S.), Dunston, Ketteringham and Framingham.

204. *P. dulcidula* Schulz.—R. : Massingham Heath, 29/8/1896, recorded as *Stropharia dulcidula* (C.B.P.).

206. *Anellaria separata* (L.) Karst.—F.C. : " Common " (C.B.P., 1872) ; localities include Taverham, Mousehold and Cringleford.

207. *A. fimiputris* (Bull.) Karst.—F.C. : " Very common " (C.B.P., 1872) ; I do not find it so common as *A. separata*. Sheringham, 15/9/1932.

209. *Amanitopsis vaginata* (Bull.) Roze.—N.I. : " Not very common ; Middleton " (C.B.P., 1872). Localities include a pasture at Aylsham, c. 1866 (K.T.), Sheringham Woods, Holt (C. P. Petch), Westwick, Stratton Strawless, Carr's Hill at Costessey and Hethersett Park.

210. *A. fulva* (Schæff) W. G. Sm.—C. : C.B.P. in 1884 list. Localities include Castle Rising, Dersingham, Holt, West Runton, Westwick, Plumstead, Stratton Strawless, Felthorpe, Horsford, Stody Wood, Drayton Druery and Wheatfen Broad. Very common in the Stratton Strawless–Horsford area.

212. *A. strangulata* (Fr.) Roze.—U. : Swardeston, 7/7/1912, Earlham Park, 3/10/1924 and West Runton, 5/10/1932.

213. *A. adnata* (W. G. Sm.) Sacc.—R. : C.B.P. in 1884 list.

214. *Volvaria bombycina* (Schæff.) Fr.—U. : Mattishall, 1882 (M.C.C.), Cke. Ill. Pl. 293) ; C.B.P. in 1884 list ; Stratton Strawless, 4/10/1934 (B.M.S.).

216. *V. Loveiana* Berk.—R. : Tottenhill, 26/10/1903 (C.B.P.) and King's Lynn, 26/10/1902 (C. Rea).

217. *V. Taylori* Berk.—R. : " This has occurred two or three times on the salt marshes near Lynn " (C.B.P., 1872) ; a specimen from King's Lynn is figured in Cke. Illust. 296. C.B.P. recorded this species again in his 1884 list and found it once more along the Sea Bank at Lynn, 6/9/1897.

219. *V. speciosa* Fr.—R. : Eaton, June, 1924, June and July, 1926, and 17 to 21 July, 1929 ; also at Great Melton, 9/10/1935.

220. *V. gloiocephala* (DC.) Fr.—N.I. : " North Wootton, June, 1871 " (C.B.P.) ; Mousehold, Drayton Brecks, Earlham Park Eaton and Carrow.

222. *V. media* (Schum.) Fr.—R. : South Wootton, 25/10/1896 (C.B.P.) and Keswick, 12/7/1920.

223. *V. parvula* (Weinm.) Fr.—U. : C.B.P. in 1884 list ; Beeston Regis, 22/9/1932.

227. *Amanita verna* (Lam.) Fr.—U. : " Bungay, August 1865 " (M.C.C., Cke. Ill, No. 1, Pl. 1) ; Ringland, 27/7/1911 ; Northrepps, West Runton and Westwick, October, 1934 (B.M.S.) ; Roughton,

Bixley Wood, Newton St. Faith's and Scottow Wood. Var. *grisea* Massee was found at Bixley, July, 1936.

::: *A. ovoidea* Bull.—S. A group of three specimens answering well to descriptions of this continental species, appeared on open brecks at Taverham, July 9th to 13th 1920. The area had been the site of a military camp, 1914–1918 and I suggest that the fungus may have been introduced by men returning from France where it is well known. It has not been met with since.

228. *A. phalloides* (Vaill.) Fr.—V.C., especially near beeches, in September ; in some seasons much more abundant than in others : it was common in many woods in 1938. This is the very poisonous " death-cap " and it has been thought well to insert a rather long list of localities on this account : C.B.P. recorded it as " common " in 1872 ; K.T. knew it from Rackheath Woods in 1866. I have found it at Sheringham, West Runton, Felbrigg Great Wood, Westwick, Sprowston, Stratton Strawless, Haynford, Horsford Heath, Swanton Novers, Bluestone Wood at Heydon, Drayton, Honingham, Melton Beck, Earlham, Dunston, Stoke Holy Cross, Framingham, Arminghall and Wheatfen Broad. Var. *umbrina* (Ferry) Maire was found in West Runton Woods, August and September, 1932.

229. *A. porphyria* (A. & S.) Fr.—N.I. : Haynford, 8/8/1912 and subsequently at Felbrigg Great Wood, Stratton Strawless (15/10/1913 and B.M.S. on 4/10/1934), and Catton Park.

231. *A. recutita* Fr.—U. : Canada Wood, West Runton, 19/9/1932 and 6/10/1932 ; Felbrigg Great Wood, 24/9/1938.

232. *A. mappa* (Batsch.) Fr.—V.C. C.B.P. in 1884 list. The type form is most commonly found growing under oaks and after that, beeches. Localities include West Runton, Felbrigg, Westwick, Horstead, Sprowston, Stratton Strawless, Horsford, Newton St. Faith's, Holt, Stody Woods, Swanton Novers, Drayton Druery, Honingham, Bawburgh, Colney, Wheatfen Broad and various parts of West Norfolk. Var. *citrina* (Gonn. & Rabenh.) Rea is not infrequent, the yellow being variable in shade ; localities include Canada Wood, West Runton, 6/9/1932 and Horsford Heath, 14/10/1904. Var. *alba* (Gillet) Rea is not infrequent and has been found at Stratton Strawless, 4/10/1934 (B.M.S.) and 11/11/1938, and at Framingham on various dates including 16/10/1937.

233. *A. muscaria* (L.) Fr.—V.C. " Common in autumn under birch trees. I have never found it elsewhere . . . ." (C.B.P., 1872). It is found especially in heathy birch scrub with scattered pines. Localities include the Lynn district, Thetford district, West Runton, Felbrigg, Westwick Perch Lake Woods, " a fir plantation at Felthorpe " (K.T., c. 1866), Stratton Strawless, Horsford, Holt (C. P. Petch), Sparham (C.B.P.), Stody, Mousehold Heath and Wheatfen Broad. Var. *formosa* Fr. is uncommon and has been found at Stratton Strawless, 4/10/1934 (B.M.S.) and St. Faith's Woods, 28/10/1937.

235. *A. solitaria* (Bull.) Fr.—R. One specimen was found in Beech Avenue at Taverham, 18/7/1936 ; this species closely resembles No. 236, but has less acute warts.

236. *A. strobiliformis* (Paul) Quél.—R. Ringstead Downs (C.B.P. in 1872 list; this may have been the specimen from " near Lynn " figured by M. C. Cooke in his " Illustrations," No. 9, Pl. 277. I found one specimen growing near but not under beeches at Taverham Beech Avenue, 17/8/1932 and two others near beeches in Honingham Park, 25/7/1936; both localities have a chalky subsoil.

238. *A. Vittadinii* (Moretti) Vitt.—R. " Mr. Amyot found this species under a gorse fence at Billingford in June, 1856; the specimens were submitted to Dr. Badham. G. E. Frere, Esq., also found it at Kenninghall in September, 1859 and it occurred again in 1862 at Royden near Diss " (C.B.P. in 1872 list).

240. *A. excelsa* Fr.—Recorded by C.B.P. in his 1884 list; probably a form of *A. spissa* Fr. (G.J.C.).

241. *A. pantherina* (DC.) Fr.—U. C.B.P. in 1884 list; West Runton, 20/9/1932 (G.J.C.) and Wheatfen Broad, 6/8/1936 (S. A. Manning).

243. *A. spissa* Fr.—N.I. Localities include Horsford Heath, 16/9/1904, Canada Wood at West Runton, Felbrigg Great Wood, Westwick, Stratton Strawless, Drayton Druery, Old Catton Park, Woodlands N. Heigham and Ketteringham.

244. *A. rubescens* (Pers.) Fr.—V.C. " Exceedingly common in fir woods " (C.B.P. in 1872 list). I have observed this species in almost all woods I have entered in every part of the county. Localities include Sheringham, West Runton, Felbrigg Great Wood, Blickling c. 1866 (K.T.), Northrepps, North Walsham Wood, Westwick, Sprowston, Mousehold (May and June, 1912—early dates), Stratton Strawless, Horsford, Holt (C. P. Petch and B.M.S.), Stody Wood, Heydon, Booton Common, Buxton Heath at Hevingham, Honingham, Woodlands at N. Heigham, Colney, Hethersett Park, Dunston, Ashby St. Mary and Wheatfen Broad.

255. *A. nitida* Fr.—R. C.B.P. in 1884 list. Boar Lane Woods at Sprowston, 22/9/1913 and 15/10/1913, also at Stratton Strawless, 26/9/1916.

246. *A. aspera* (Fr.) Quél.—R. Recorded from " West Norfolk " by Rev. G. Munford in White's " Norfolk," 1864; also Foxley Wood, 1872 (K.T.). The identity of this species is very doubtful (G.J.C.).

250. *Armillaria robusta* (A. & S.) Fr.—R. Horsford Heath, 19/10/1911 and Westwick Perch Lake Wood, 4/10/1933.

253. *A. ramentacea* (Bull.) Fr.—R. Pentney, 1900 (C.B.P.) and King's Lynn, 25/10/1902 (C. Rea).

257. *A. mellea* (Vahl.) Fr.—V.C. throughout the county and in various forms. C.B.P. in 1872 stated that he found it " not common around Lynn," having met with it only twice, and that Mr. Amyot had found it near Diss. This seems rather extraordinary and goes to indicate that it has increased of late years. Localities include Bawburgh, 1904; Stratton Strawless, 1904; Colney Park, 1911; Sprowston, 1910; Haveringland, 1911 and subsequently in most

parts of the county, including Costessey Park, East Carleton, Attlebridge, Felbrigg, Holt (C. P. Petch), Northrepps, Westwick, Plumstead, Stratton Strawless, Easton, St. Faith's woods, Burnt Fen, Framingham and Wheatfen Broad.

261. *A. mucida* (Schrad.) Fr.—F.C. Given in C.B.P.'s list of 1884. Gunton Park, 19/8/1913 ; on beech and oak at Westwick, 1933–35 ; Keswick and in plenty at Felbrigg Great Wood, 25/9/1938. It is common in north Norfolk, and is apparently on the increase.

264. *Pholiota terrigena* Fr.—R. Recorded from Norfolk by C.B.P. as this species and as *P. Cookei* Fr. in his 1884 list.

265. *P. erebia* Fr.—U. King's Lynn, September, 1883 (Cke. Ill, 377 t. 358) ; C.B.P. in 1884 list ; Westwick, Octobers 1933–35 ; Northrepps, October, 1934 (B.M.S.).

267. *P. molliscorium* Cke. & Massee.—A scattered group on high exposed ground (210 feet above O.D.) at Salthouse Heath, 17/6/1936. The specimens found somewhat resembled a very yellow form of *P. dura*, but a careful examination led me to determine them as above.

268. *P. togularis* (Bull.) Fr.—F.C. " Not rare in gardens " (C.B.P., 1872, under the name of *Agaricus arrhenii* Fr. and in 1884 list as *P. togularis*). Localities include West Runton, Northrepps, Westwick (B.M.S., October, 1934) ; Newton St. Faith's (E.A.E.), Mousehold, Sprowston, Gt. Melton, Framingham and How Hill at Ludham.

270. *P. dura* (Bolt.) Fr.—F.C. King's Lynn (C.B.P., 1872) ; Eaton, 16/7/1927 ; found in several localities during 1936, which seemed to be an especially good year for it, e.g. at Castle Rising, Oddy's Wood at Holt, Ringland, Eaton, Dunston and Lakenham. Found at West Runton, 12/10/1938.

271. *P. præcox* (Pers.) Fr.—C. (in some seasons). C.B.P. recorded as " common, June and July " in 1872. Localities include Salthouse Heath, Cromer, Mousehold, St. Faith's Common, Taverham, Drayton Druery, N. Heigham, Cringleford, Eaton (Golf Links, etc.), Dunston common, Swainsthorpe, Wheatfen Broad, Woodbastwick (B.M.S.), Sutton Broad, Crome's Broad and How Hill, Ludham. Var. *minor* (Batt.) Fr. was found on soil in a flower-pot at N. Heigham, 17/5/1912 and at Hapton, 17/6/1936.

273. *P. radicosa* (Bull.) Fr.—R. C.B.P. stated in his 1872 list that he found this " not uncommon," recording also that Mr. Amyot found it near Diss. The only recent occurrence known to me is that at Wheatfen Broad, 5/10/1934 (B.M.S.).

274. *P. pudica* (Bull.) Fr.—R. " On an elder stump, North Wootton " (C.B.P., 1872).

276. *P. ægerita* (Porta) Fr.—U. C.B.P. included this (also as *P. capistrata*) in his 1884 list. Norfolk specimens were figured by M. C. Cooke in his " Illustrations," Nos. 386 t. 453 and 387 t.385, the former found on ash at King's Lynn, 14/7/1884 (M.C.C.) and the latter on elm there (W. Phillips). This species appeared on an elm stump in the Water Lane at Costessey, 6/8/1914 and a second crop in the same

place, 18/11/1914 ; again, 15/11/1916. Other clumps were found at Old Lakenham, August 1920 ; Trowse, 4/6/1922 (B.M.S.) and Saxlingham Green, July, 1937.

278. *P. destruens* (Brond.) Fr.—U. " I have had this species several times from Norfolk, generally from poplar " (Carleton Rea in litt., 20/6/1936). Found also on willows at Haddiscoe Dam, 1/6/1936 and Whitlingham in November, 1938 by M. B. Ellis.

279. *P. heteroclita* Fr.—R. Recorded by C.B.P., 1884.

280. *P. aurivella* (Batsch) Fr.—R. Recorded by C.B.P., 1884.

281. *P. squarrosa* (Mull.) Fr.—F.C. " Usually found on ash " (C.B.P., 1872). On an ash trunk at Woodlands Park, N. Heigham, June to September, 1912 ; on the same in October, 1913 and again in October, 1921. On oak at Bawburgh, October, 1913, and East Carleton, 18/10/1938 ; on beech at Marlingford and Taverham ; found also (wood not specified) at Costessey Park, Attlebridge and Sprowston (B.M.S.). Var. *Mulleri* Fr. appeared on a beech trunk at Costessey, 27/10/1910.

283. *P. grandis* Rea—R. Found at Bawburgh, 30/9 to 4/10/1933.

284. *P. spectabilis* Fr.—N.I. " On fir stumps " (C.B.P., 1872). Localities include Northrepps, Sprowston, Framingham and Swanton Novers, October, 1934 (B.M.S.) ; Felbrigg Great Wood, Westwick, Stratton Strawless, Great Melton and Dunston Common.

285. *P. adiposa* Fr.—R. Recorded by C.B.P., 1884.

286. *P. lucifera* (Lasch.) Fr.—R. Scottow, 23/7/1936.

287. *P. flammans* Fr.—U. Northrepps Hall Woods, 2/10/1934 (B.M.S.).

288. *P. tuberculosa* (Schæff.) Fr.—R. Felbrigg Great Wood, 24/9/1938.

291. *P. erinacea* (Fr.) Quél.—N.I. in sallow-carrs. Castle Rising, April, 1872 (M.C.C.), on sallow branches at Hoveton St. John, 22/5/1932 (E.A.E. and H. J. Thouless) ; Wheatfen Broad in March, April, July and November, between 1933 and 1938 (E.A.E. and M. J. D. Cockle) ; Stoke Holy Cross (E.A.E. and G.J.C.).

298. *P. mutabilis* (Schæff.) Fr.—N.I. North Wootton (C.B.P., 1872) ; Westwick, 4/10/1933 and 30/10/1935 ; Thorpe, 5/6/1932 (B.M.S.) ; Wheatfen Broad, 30/5/1936 and Bluestone Wood at Heydon, 2/10/1937.

299. *P. marginata* (Batsch.) Fr.—C. " Common " (C.B.P., 1872) ; localities include Sheringham Woods, Stody, Westwick (B.M.S.), Drayton (including some on pine cones, 18/11/1938), Earlham and Eaton.

302. *P. unicolor* (Fl. Dan.) Fr.—U. C.B.P. in 1884 list ; Plumstead Woods, 5/10/1934 (G.J.C.) and Yarmouth Denes, 28/12/1934 (E.A.E.).

303. *P. pumila* Fr.—U. C.B.P. in 1884 list ; Taverham, 13/11/1931.

304. *P. mycenoides* Fr.—R. " In a mossy hollow, Rising Heath " (C.B.P., 1872).

*C. Rea., Appendix II to " British Basidiomycetae ", Trans. Brit. Myc. Soc., XVII, 36.

†C. Rea, Appendix to " British Basidiomycetae ", T.B.M.S., XII, 208.

To be continued.

XII

FAUNA AND FLORA OF NORFOLK
MISCELLANEOUS OBSERVATIONS

NOTE—Where not otherwise stated, E. A. Ellis is responsible for these records. Species marked * are " new " to Norfolk.

PLANTS

ALGÆ—**Lyngbya martensiana* Gom. was growing on a damp wall under a bridge at Spixworth, June 1938. (S. A. Manning).
**Gleotrichia natans* (Hedw.) Rabenh. was floating in jelly-like masses at Wheatfen Broad, 7–7–38. (M. J. D. Cockle).

LICHENES—The following species of *Cladonia* were collected from the brecks at Tottington in February and March, 1938 by Miss E. R. Noble and determined by S. A. Manning :—*uncialis* Web. (typical form), *cariosa* Spreng. *foliacea* Willd., *pyxidata* Hoffm., *macilenta* Hoffm., *coccifera* Willd., *pityrea* (Flk.) Fr. form *scyphifera* (Del.) Wain., *floerkeana* Fr. var. *carcata* Wain. and *sylvatica* Hoffm.

GASTEROMYCETES—*Geaster bryantii* Berk. was plentiful under a pine on rather sandy ground at Stoke Holy Cross in the autumns of 1937 and 1938. (G. C. H. Chandler). *Geaster limbatus* Fr. was discovered growing on a hedge-bank at Drayton, 14–4–1938. (R. M. S. Brown.) *Geaster mammosus* Chev. : a gathering of this rare earth-star was made on a bank of Hellesdon Hall Lane some years ago by Mr. H. Lindley Jones (specimens in Norwich Castle Museum). *Geaster fimbriatus* Fr. : the single record of this species in Norfolk given in the first section of " Norfolk County List of Fungi " should be added to as follows—M. J. Berkeley referred to Rev. R. B. Francis' finding it in Norfolk (Brit. Fungi, An. & Mag. Nat. Hist., 1844) ; colonies were found under ash, beech &c. at Sheringham, 29–10–36 and under spruce and larch at Drayton woods, 15–10–38. (G. J. Cooke). *Geaster triplex* Jungh. was growing under holly and holm oak at Clippesby, 4-11-38 (R. Gaze and H. J. Howard) and a large colony under holly and deciduous trees at Stoke Holy Cross later in the same month. (G. C. H. Chandler).

UREDINALES—*Puccinia arenariae* (Schm.) Wint. teleutospores were present on glaucous marsh stichwort, *Stellaria dilleniana palustris* at Alderfen Broad 13–8–1938 (a new British host record).
P. bullata (Pers.) Wint. has been found on milk parsley at Ormesby St. Michael, Alderfen Broad, a fen bordering the river Ant at Neatishead, Crome's Broad at Ludham and Alderfen Broad, 1935-38.
P. adoxæ Hedw.f. on moschatel at Hethersett Hall, Dunston (R. M. S. Brown) and Spixworth (T. Notley), 1937-38.
P. ambigua (Alb. & Schw.) Lagh on goose-grass at Catfield, Hethersett and Upton Broad, 1935-38.
P. cyani (Schlecht.) Pass. on cornflower at Costessey, August, 1938 (S. A. Manning).
P. tragopogonis (Pers.) Cda. on goatsbeard, Upper Hellesdon, 14–7–38.
P. glechomatis DC. on ground ivy at Catton, Stoke Holy Cross and Wheatfen Broad, 1938.

**P. porri* (Sow.) Wint. uredospores and teleutospores were found ruining an onion crop near Norwich in June, 1938 (G. E. Deacon). *P. dioicae* P. Magn. In " Rust Fungi of Norfolk " (Trans. Norf. & Norw. Nat. Soc. XIII, 496) it is stated that teleutospores of a *Puccinia* possibly this species had been gathered on *Carex dioica* at Flordon Common by W. H. Burrell, but that the aecida had been searched for on *Cirsium palustre* there and not found ; however, the aecidia were discovered at Flordon subsequently (14–7–1935) and it is practically certain that Burrell's gathering is of *P. dioicae*. The aecidia are abundant annually at Buxton Heath, Hevingham, but so far *Carex dioica* has not been found there with the later spore stages. Aecidia were noticed at Booton Common 27–6–1935, but again no rusted sedge was found in close proximity ; a visit was made to this locality on 9–7–1938 when all stages of the rust were found, the uredo—and teleuto-spores on *Carex dioica*. Material was kept under observation at Norwich Castle Museum and the sedge was infected directly by aecidiospores from *Cirsium palustre*.

Uromyces ficariae (Schum.) Lev. has been found both on typical *Ranunculus ficaria* and its variety *bulbifera* in Norfolk during 1938.

U. geranii (DC.) Otth. & Wartm. aecidia were found on *Geranium pratense* at Horsey Hall, 5–5–38.

U. scillarum (Grev.) Wint. on wild bluebells at Frettenham and Melton Constable, April, 1938 (R. M. S. Brown).

U. poae Rabh. aecidia were noticed both on typical *Ranunculus ficaria* and its variety *bulbifera* in Norfolk in 1938.

Kuhneola albida (Kuhn.) P. Magn. The earliest find of this bramble rust in Norfolk appears to have been that of C. B. Plowright, who found it at East Winch, 4–9–1899 (Plowright M. S. from T. Petch). *Melampsora hypericorum* (DC) Wint. was present on tutsan at Heydon Grange, 2–10–37.

Coleosporium euphrasiae (Schum.) Wint. was found on eyebright at Bryant's Heath, Felmingham and Upton Broad by members of the British Botanical Society & Exchange Club during August, 1938.

ANGIOSPERMÆ—*Ranunculus ficaria* L. In response to an enquiry from the Association for the Study of Systematics in Relation to General Biology, as to the distribution of two growth forms of lesser celandine in Norfolk—one with bulbils in the leaf-axils and one without—local observers collected the following information. Colonies *without bulbils* were found at Caistor (marshes by River Tas and in open situations on three hedge-banks), Dunston (three roadside patches), Flordon Common, Haynford (plants short stemmed, in dry situations), Hoveton St. John, North Wootton, Norwich (Marston Lane and a footpath by the River Wensum near Mile Cross Road), Mulbarton, Pulham St. Mary (in an open field), Rackheath Park, Runcton Holme (on sandy soil), Saxlingham Thorpe (with flowers and few or no bulbils in a sunnier situation than those mentioned from the same locality later), Spixworth, Stoke Holy Cross (in open and in dry situations under trees), Surlingham (on two roadside banks in the village, at No. 1 Brickyard, in a mixed patch at Wheatfen Broad and alternating with plants showing bulbils near Surlingham Ferry), Taverham, Trunch, and Whitlingham Lane (in part) ; it is of interest to note that all the plants examined in Lothingland by Mr. C. G. Doughty and E.A.E. were normal, viz. at Gorleston, Bradwell, Hopton, Fritton, St. Olave's Priory and Blocka Lane, Herringfleet, in all

kinds of situations. The form **bulbifera* was found at Caistor (five patches somewhat shaded by trees), Earlham Park (on damp meadow and dry field, all of this form), Haynford (large plants with many bulbils and few flowers growing under hazels), Norwich (one plant among many without bulbils, by River Wensum), Saxlingham Thorpe (with many bulbils and no flowers in a wet copse), Shotesham (with bulbils and flowers in a ditch), Surlingham (a few in No. 1 Brickyard and on Home Marsh Staithe at Wheatfen and many at Surlingham Ferry), Trunch (twelve plants, a small percentage), Whitlingham Lane (many), and Wroxham. Most of the above were found by R. M. S. Brown, others by M. J. D. Cockle, E. T. Daniels, E. A. Ellis, A. J. Hunter, S. A. Manning, R. Sewell and Miss A. Widger.

Hesperis matronalis L.—Dame's violet was found abundantly naturalised near a small broad at Clippesby, where it was attacked by larvae of the orange-tip butterfly (H. J. Howard and R. Gaze), June 1938.

Stellaria aquatica Scop.—Great chickweed was flowering at Costessey in September (M. B. Ellis) and by the River Yare at Lakenham in October, 1938.

Claytonia perfoliata Donn. was noticed at Lime Tree Road, Norwich in 1938 (Miss M. Kerridge).

Impatiens parviflora DC. is newly recorded from Brampton, Norfolk.

Ilex aquifolium L.—Holly flowered early (e.g. May 1st at Gt. Yarmouth) in 1938 ; an unusual case of second flowering was observed at Ashby St. Mary where male blossoms were found in some numbers on October 27th.

Viburnum opulus L. var. **flavum* Horwood—Guelder rose with orange translucent berries was noticed at Wheatfen Broad, 8–9–38 and determined by Mr. A. A. Bullock (M. J. D. Cockle).

Achillea ptarmica L.—Sneezewort was discovered at Buxton Heath, Hevingham in August 1938 (G. E. Deacon).

Tragopogon porrifolius L.—In the hybrid colony in Vauxhall Station yard at Gt. Yarmouth the earliest flowers of the parent *T. porrifolius* were seen on April 26th, 1938 ; during May it was found that the hybrids were heavily attacked by the smut *Ustilago tragopogi* (Pers.) Schrot.

Calystegia sepium Br.—Flowers of great bindweed at Wheatfen Broad were visited by honey bees, *Apis mellifera* L. on the morning of August 11th, 1938 and subsequently ; this fact is recorded in view of the current idea that bees do not visit these flowers (M. J. D. Cockle).

Antirrhinum orontium L. was found at Horning in 1938 (C. J. Brooks).

Lamium galeobdolon Cr.—Yellow archangel was flowering abundantly at Spixworth, April 4th, 1938 (T. Notley).

Rumex pulcher L.—Fiddle dock was present in fair quantity near the Roman station at Caistor, 30–6–38.

Ceratophyllum demersum L. and *C. submersum* (L.), the latter from dykes, were both collected in flowering condition at Wheatfen Broad 7–7–1938 (M. J. D. Cockle) ; the latter species was found also in a dyke at Upton Road, 14–8–38.

Liparis loeselii Rich.—The rare fen orchis was discovered at Upton in 1938 (British Botanical Society excursion).

Orchis hircina Crantz.—The lizard orchis found at Cringleford in 1936 flowered again in 1937 and 1938 ; it dies down after flowering and comes up again in October, standing through the winter, when it is protected with a cloche (Miss B. Foster).

ANIMALS.

CRUSTACEA—*Niphargus aquilex* Schiodte. Blind shrimps apparently of this species were found in a well at Stoke Holy Cross vicarage in 1937 (G. C. H. Chandler).

ARACHNIDA—*Epitetranychus lintearius* (Duf.). These mites were web-spinning on furze bushes at Frettenham, 11–3–38 (A. N. Garrett).

ORTHOPTERA—*Gryllus domesticus* L. House crickets were found on a centrally heated cabin boat lying at Brundall in March, 1938.

ODONATA—*Aeshna mixta* Latr. Dragonflies of this species were taken at Gt. Yarmouth in late August and two males as late as October 4th, 1938, at Wheatfen Broad (R. Sewell. *Sympetrum striolatum* Charp. : this species was found paired at Wheatfen on November 2nd, a very late date (M. J. D. Cockle). *Sympetrum sanguineum* Mull. was common at Thompson Water during August (B. A. Cooper) ; several were still flying at Wheatfen on October 20th (M. J. D. Cockle).

HETEROPTERA—*Microphysa pselaphiformis* Curt. : numbers of these very small plant-bugs were seen probing and apparently sucking up fluid from the lichens *Xanthoria parietina, Physcia hispida* and *Buellia canescens* on old gravestones in Catfield churchyard, 26–5–38. **Hydrometra gracilenta* Horvath : G. A. Walton (Ent. Mo. Mag. LXXIV, 272) recorded this pond-skater as new to the British fauna from Barton Broad in August, 1938. There is one specimen of this among *H. stagnorum* (L.) in the late Mr. H. J. Thouless's collection in Norwich Castle Museum ; it is unlocalised but most probably from Norfolk.

HOMOPTERA—**Aphrophora maculata* Edw. : a single example of this leaf-hopper was collected by M. J. D. Cockle at Wheatfen Broad, 20-6-1938 and is now in the series of Norfolk Homoptera at Norwich Castle Museum.

COCCIDAE—*Newsteadia floccosa* (De Geer) Green : several of these insects were found among mosses and sedges in a boggy part of Saxlingham Thorpe Common, 10–10–38.

MEGALOPTERA—A female snake-fly, *Raphidia xanthostigma* Schum., was found at Wheatfen, 8–68–3 (M. J. D. Cockle).

LEPIDOPTERA—*Phragmatobia fuliginosa* L. : a freshly emerged female ruby tiger moth was picked up from the road at Horning, 10–4–38 (E. T. Daniels). *Macroglossa stellatarum* L. : few hummingbird hawk moths appeared in Norfolk during 1938. October specimens were seen in Norwich Castle gardens (at dahlia bloom) by T. Notley, at Tottingham (Miss E. R. Noble) and Hethersett (H. W. Back).

Deilephila nerii L. : an oleander hawk moth visited a garden in Bracondale, Norwich, 28–7–38 (H. G. Day). *Acherontia atropos* L. : many caterpillars of the death's-head were found on potato plants in various parts of the county during August and September, 1938—at Acle, Banham, Beccles, Blofield, Brundall, Caston, Geldeston, Great Yarmouth, Martham, Mundesley; Warham, Worstead, Wymondham, etc.

Vanessa atalanta (L.) : red admirals were rather scarce in Norfolk du ing early summer but became common in October. The first seen were seven flying among trees at How Hill, Ludham, on June 9th : other summer records (June and July) came from Rockland and Neatishead (E. T. Daniels), Haddiscoe and Horsey.

A very late specimen was noted at Haynford, November 14th (A. E. Mahood). *Vanessa cardui* (L.) : painted-lady butterflies were observed in Norfolk during 1938 as follows—one at Ludham, June 9th ; one at South Walsham, 16th ; one at Poringland, 24th (E. T. Daniels) ; one much faded at Horsey Mere, 26th ; several at Spixworth, August 9th (T. Notley) ; a few in the Norwich district during early October. *Polygonia c-album* (L.) the comma butterfly was in evidence in both west and east Norfolk during 1938. One was seen at blossoms of Crocus and Aubretia in the gardens of Hethersett Hall, 12th March, and others there in September and October, one of these was a cripple and must have hatched out at Hethersett (H. W. Back). Between July 27th and mid-October specimens were noticed as follows : one at Caston near Attleborough (T. S. N. Hardinge), one on Buddleia at Spixworth (T. Notley), one on Buddleia at Horning (C. J. Brooks), one at Bressingham (J. E. Hall), Hainford (A. E. Mahood), Tottington and Merton (Miss E. R. Noble and Lord Walsingham), Taverham (A. L. Carr), Wheatfen Broad (R. Sewell) and one on Phlox at Sporle near King's Lynn (R. G. Buxton).

Nymphalis polychloros (L.) : large tortoiseshells were noticed singly at Costessey and Hellesdon, 7–8–38 (E. T. Daniels).

Limenitis camilla (L.) : white admirals were seen again in 1938 at Horsford, Felthorpe and Wheatfen. *Strymon w-album* (*Knoch*) : a pair of white-letter hairstreak butterflies appeared at Caston near Attleborough, 23–7–38 (T. S. N. Hardinge).

Euchloe cardamines (L.) : orange-tips were flying very early in 1938, e.g. on April 4th at Wheatfen and continued until mid-June. Messrs. H. J. Howard and R. Gaze came upon numbers of the caterpillars feeding on dame's-violet at Clippesby in early July. *Colias hyale* (L.) : one pale clouded yellow was seen near Norwich Waterworks on August 7th (E. T. Daniels).

Colias croceus (Fourcr.) : clouded yellows were seen in Norfolk sparsely during the latter part of the year, viz. one at Spixworth on August 9th (T. Notley), one at Upton Broad, August 14th, several with one female var. *helice* at Harleston on September 2nd (Stovin and Huggins) and one male at Sporle on September 11th (R. G. Buxton). *Papilio machaon* (L.) : an exceptionally early swallowtail was on the wing at Ludham on March 31st, 1938 (E. T. Boardman). *Aphomia sociella* L. : moths hatched from bees' nest cocoons found at Mundham as follows : May 17th to 29th, 30 males ; one female on May 30th and large numbers of both sexes from then onward to the middle of June ; the females on emergence were seen to fold their wings perpendicularly (butterfly fashion) till quite dry, then flat in the normal way ; but the males did not do so.

Stenoptilia zophodactyla Dup. : larvae of this plume moth were found on centaury flowers at Wolferton 19-9-38 (Miss D. K. Rudd) ; they pupated within a week and two moths emerged 22–10–38 (J. Goddard). *Hyponomeuta rorella* Hb. : willow ermines are spreading in Norfolk ; larvae were abundant near Acle Bridge, 3–7–38 (H. J. Howard) and moths were taken at Wheatfen Broad during early August (M. J. D. Cockle).

Aculeata—*Pemphredon lugubris* Latr. : a large colony of these small dark wood-burrowing wasps was found in a garden on City Road, Norwich during the summer of 1938 (C. F. Prentice).

Diptera—*Chrysops* spp. : these vari-coloured blood-sucking clegs are called " Harlequin flies " by marshmen at Acle.

Pisces—*Nerophis aequoreus* L. : a snake or ocean pinefish was found washed up on Sheringham beach during April, 1938.
Cottus bubalis Euph. : long-spined sea-scorpions were dredged from the main channel at Blakeney Piant in September, 1938 (L. W. Loyd). *Clupea finta* Cuv. : a large twaite shad was caught with rod and line off Eccles, 3–7–38 (T. H. Palmer).

Amphibia—*Bufo calamita* L. : natterjack toads were discovered living at Bryant's Heath, Felmingham during 1938 (A. E. Ellis).

Mammalia—*Sorex minutus* L. : a pigmy shrew was found at Taverham Mill, 18–7–38 (L. W. Lloyd).

GEOLOGY.

A Chalk Pit at Caistor. This pit, which is situated 100 yards east of the Norwich-Hempnall road, two miles south of Norwich and approximately half-a-mile north of the Caistor cross roads, has been worked recently for lime-burning and for material needed by the local catchment board in making up river banks. The chalk is covered by about four feet of light soil and marl, and has a face of about 20 feet. Six layers of flint are exposed at fairly regular intervals on the main face and three more are reached when " sinks " are dug at the foot. The largest flint block found there was rather over four feet square and several paramoudras have been removed, most being somewhat fragmentary, as the chalk is heavily faulted. Typical *Belemnitella mucronata* zone fossils are present. *B. mucronata* and *B. lanceolata* are both very common, the latter the more so, also *Echinocorys scutatus*, *Terebratula carnea* and *Nautilus rediciius*. Other species found, mostly between the fifth and eighth layers of flint, proceeding downwards, include *Echinoconus* sp., *Pleurotomaria perspectiva*, *Turrilites*, *Micraster*, *Rhynchonella limbata*, **Typocidaris* cf. *subvesiculosa* (apparently a new species), *Trochosmilia laxa*, *Ostrea inaequicostata* and teeth of *Lamna appendiculata*, *Notidanus microdon*, *Cimolichthys lewesiensis*, *Enchodus lewesiensis*, *E. halcyon*, **Apateodous* sp., **Synechodus* sp. near *recurvus*, *Corax falcatus* and *Scaphanorhynchus subulatus*. Determinations were carried out by Mr. C. P. Chatwin of the Geological Museum (G. C. H. Chandler).

XIII.

OBITUARY.

DR. SYDNEY HERBERT LONG.

Born 1870. Died January 15th, 1939.

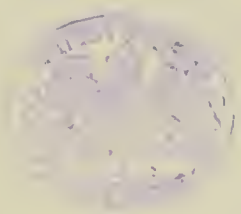
Naturalists from far beyond the borders of his beloved County, many of them from overseas have realized that the mainspring of the study of Natural History in Norfolk has been Dr. Sydney Long. To the question, "What is the Norfolk and Norwich Naturalists Society?" or "What is the Norfolk Naturalists Trust?" the common answer has been, "Well it's really Dr. Long."

A compact figure, topped with an old brown felt hat, shading a shrewd and kindly face with a pair of twinkling blue eyes and a most attractive moustache, sitting in an open motor dated partly by its appearance and the rattlings it emitted, still more by the ancient carriage rug which seemed an inseparable companion of the car and its occupant. That is the picture which the people of Norfolk will remember when they think, as they often will, of Dr. Long out on one of his numerous excursions to the coast the broads or the brecks. There he loved to welcome and to watch the birds, for whose preservation he has done more than any man in the County.

Fortunately for all of us and for the wild things he set out to preserve, Dr. Long in addition to being a first class naturalist, skilled and sure in eye and ear and thoroughly well read, was a most capable administrator. Thanks to these qualities the Naturalists' Society, of which he was honorary secretary for twenty-four years until 1936 when he retired, and the Norfolk Naturalists' Trust, which he founded in 1926 and has fathered ever since, have acquired a reputation for vigour, good mangement, and the successful pursuit of Natural Science, which extends far beyond the county of Norfolk. More than that, Dr. Long knew good writing and was intolerant of careless or unskilled records. He helped more than anyone else to ensure that Norfolk should have much to show from her store of wild life, and that what was seen should be ably and vividly recorded.

Photo Layfayette, London

DR. SYDNEY HERBERT LONG
1870—1939



For many years until his death he produced "The Report of the Wild Birds Protection Committee" which was published separately and also included every year in the "Naturalists Transactions." For many readers it undoubtedly formed the most attractive feature of that publication. His famous Christmas Cards of paintings by Mr. J. C. Harrison of Norfolk birds were sent to 40,000 people last year. In March, 1926, Dr. Long founded the Norfolk Naturalists' Trust and propounded at a luncheon at Cley his idea of a Trust, with powers similar to those of the National Trust, for acquiring properties in the county of importance from the point of view of Natural History. The Trust with the Lord Lieutenant, Mr. Russell Colman as president, has 150 life members, and owns properties valued at over £14,000 at Brancaster, Cley, Lakenheath, Salthouse, Alderfen, and Martham. Dr. Long as its honorary secretary and treasurer has been responsible for the management of these properties, the collection of subscriptions, and the appointment and payment of the watchers, who were his devoted servants and friends. It was he who started the idea of securing Scolt Head Island for the National Trust and it was largely due to his efforts that the £600 required for its purchase was raised. He subsequently became the honorary secretary of the Scolt Head Committee.

This record of Dr. Long's career as an active practicing naturalist is all the more remarkable, when it is remembered how little spare time he had to engage in his hobbies. Born at Wells in 1870 he followed the profession of his father Dr. Frederick Long, who was in practice in that town. He was educated at Epsom and Caius College, Cambridge and completed his medical studies at the University College Hospital. Subsequently he was appointed house physician to the Norfolk and Norwich Hospital, when the late Sir Hamilton Ballance was house surgeon. For forty years he was physician both to the Norfolk and Norwich and to the Jenny Lind Hospitals. He was chairman of the Jenny Lind in 1936 a year when he might otherwise have been chairman of the Norfolk and Norwich. For many years he was chairman and leading spirit of the Committee of the Fletcher Convalescent Home at Cromer and also Medical Officer of Health to St. Faiths Rural District Council. He was a first class man on a committee

and took throughout a most active part in the administration of all these institutions, where he was the friend and confidant of all the staff. He had a knack of gaining the confidence of his patients not only by what he said but by the shrewd and kindly way he said it.

At the end of a hospital meeting he would look round for a fellow naturalist to exchange the latest information on the birds. I recall one such conversation when he related with delight how he had been stalked and caught on one of his own Trust properties by a keen and suspicious watcher, who had failed to identify him from a distance. It is difficult to see who can really take his place for he was the life and soul of all the Institutions that have given Norfolk its name for efficient preservation and study of wild life.

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