



TRANSACTIONS
OF THE
Norfolk and Norwich
NATURALISTS' SOCIETY

PRESENTED TO MEMBERS FOR

1926—27

VOL. XII.—PART III

NORWICH
PRINTED BY A. E. SOMAN & Co.
DECEMBER, 1927



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TRANSACTIONS
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1. The practical study of Natural Science.
2. The protection, by its influence with landowners and others, of indigenous species requiring protection, and the circulation of information which may dispel prejudices leading to their destruction.
3. The discouragement of the practice of destroying the rarer species of birds that occasionally visit the County, and of exterminating rare plants in their native localities.
4. The record of facts and traditions connected with the habits, distribution, and former abundance or otherwise of animals and plants which have become extinct in the County ; and the use of all legitimate means to prevent the extermination of existing species, more especially those known to be diminishing in numbers.
5. The publication of Papers on Natural History contributed to the Society, especially such as relate to the County of Norfolk.
6. The facilitating of a friendly intercourse between local Naturalists by means of Meetings for the reading and discussion of papers and for the exhibition of specimens, supplemented by Field-meetings and Excursions, with a view of extending the study of Natural Science on a sound and systematic basis.
7. Any Member who, in the opinion of the Committee, contravenes the objects of the Society is liable to have his name erased from the List of Members.

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 1924 Chittock Mrs. A. T., 12 Chapel Field North, Norwich
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 1903 *Colman Miss H. C., Carrow Abbey, Norwich
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 1921 Cozens-Hardy A., Oak Lodge, Sprowston, Norwich
 1926 Cozens-Hardy E. W., Oak Lodge, Sprowston
 1886 Cross J. M., Acle
 1926 Cruickshank W. G., 11, Hammersmith Terrace, London, W.C.6

D

- 1910 Dalby Rev. Alan, M.A., The Vicarage, Leamington-Hastings,
 Rugby
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 1920 Davey Guy, Aldborough, Norwich
 1927 Davies, Miss H., Branksome Road Norwich
 1914 Davies H. C., Old Lakenham, Norwich
 1923 Daukes Maj. A. H., 22, Egerton Terrace, London, S.W. 2
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 1926 Day, J. Wentworth, 61a, Pall Mall, London, S.W.1
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 1925 Dew Mrs., Boat House, Blakeney
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E

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 1877 Edwards J., F.E.S., *Hon. Mem.*, Colesborne, Cheltenham
 1924 Elliott T. B., 8, Brunswick Road, Norwich
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F

- 1885 Falcon Michael, Sprowston Hall, Norfolk
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 1923 Fisher Sidney, Oaklands, St. Clement's Hill, Norwich
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 1924 Fowler Miss E., Gunton Old Hall, Lowestoft
 1922 Frere Sir Bartle H. T., South Walsham Hall, Norfolk
 1926 Fuller A. W., 18, Kerrison Road, Norwich

G

- 1927 Garnett, R. M., Bridge House, Prestbury, Cheshire
 1902 Garstang Walter, D.Sc., The University, Leeds

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- 1924 Gay Miss Ellen, Thurning Hall, Guist, Norfolk
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 1925 Gay Miss G. A., Ardleigh House, Hornchurch, Essex
 1926 Gayner J. S., Hall Cottage, New Earswick, York
 1922 Gaze R., 105, Earlham Road, Norwich
 1903 Geldart Miss Alice M., Cotman Road, Norwich
 1926 Gilbert Brig.-Gen. A. R., C.B.E., D.S.O., Sprats Green, Aylsham
 1926 Gilbert Mrs. A. R., Sprats Green, Aylsham
 1908 Gilbert R. T. E., Ashby Hall, Norfolk
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 1921 Glover T., Cliff House, Norwich
 1909 Goodchild Herbert, The Chestnuts, Unthank Road, Norwich
 1901 Goose A. W., 10, Sandringham Road, Norwich
 1922 Gossage Mrs., Leet Hill, Kirby Cane, Norfolk
 1922 Gossage Col. W. W., Leet Hill, Kirby Cane, Norfolk
 1921 Graves Mrs., Oulton Lodge, Aylsham, Norfolk
 1919 Greatorex H. A., Witton, Norwich
 1921 Green Capt. S. V., Sutton Lodge, Ipswich Road, Norwich
 1924 Green Maj. E. A. Lycett, Ashfield, York
 1918 Gresham School The, Holt, Norwich
 1913 *Grey of Fallodon, The Rt. Hon. Viscount, K.G., *V.P.*, Fallodon,
 Lestbury, Northumberland
 1926 Gunn F. E., 84, St. Giles Street, Norwich
 1918 Gurney Major Cecil F., Berry Hall, Walsingham
 1896 *Gurney Sir Eustace, M.A., F.Z.S. *V.P.*, Walsingham Abbey,
 Norfolk
 1893 *Gurney Gerard H., F.Z.S., Keswick Hall, Norwich
 1901 Gurney Q. E., Bawdeswell Hall, Norfolk
 1894 *Gurney Robert, D.Sc., F.L.S., F.Z.S., *Hon. Treasurer*, Ingham
 Old Hall, Norfolk
 1918 Gurney Mrs. Robert, Ingham Old Hall, Norfolk

H

- 1924 Hadfield Travers. Stoneleigh, Knutsford, Cheshire
 1892 *Haigh G. H. Caton, Grainsby Hall, Great Grimsby
 1905 Halls H. H., 130, Hall Road, Norwich
 1926 Hammond C. R. A., Sprowston Grange, Norwich
 1908 Hamond Lieut.-Com. C.E., R.N., 40, Lyndhurst Road, Lowestoft
 1906 *Hamond Major Philip, D.S.O., Morston, Holt, Norfolk
 1923 Hankin E. H., Sc.D., *President*, Brent Bridge Hotel,
 London, N.W. 4
 1923 Harbord Miss P., Mousehold House, Norwich
 1919 Harker Miss Sylvia, Blofield Hall, Norwich
 1908 Harker William, Blofield Hall, Norwich
 1923 Harmer Russell T., The Grange, Rackheath, Norwich
 1881 *Harmer Sir Sidney, K.B.E., F.R.S., *V.P.*, The Old Manor
 House, Melbourn, near Royston, Herts.
 1925 Harper Mrs. A. M., The Mansion, Great Yarmouth
 1906 Harris Rev G. H., St. Paul's Vicarage, 47, Trafalgar Road,
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 1923 Hastings Lord, Melton Constable Park, Norfolk
 1925 Hemingway P. H., Hamara, Wrexham
 1926 Herbert E. G., Braken How, Sheringham
 1925 Hewitt H. Dixon, F.I.C., 25, Croxton Road, The'for 1
 1925 Heywood R., Pentney House, Narborough, Norfolk
 1923 Hibberd Rev. H., Burnham Thorpe Rectory, King's Lynn
 1893 *Hill Alexander, M.D., F.R.S., Highfield Hall, Southampton

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- 1919 Hinde Dr. E. B., 31, Mount Pleasant, Norwich
 1891 Hinde F. C., *Hon. Librarian*, Oaklands House, Cringleford,
 Norwich
 1923 Hines E. S., 10, Parker Road, Norwich
 1915 Hitchcock Arthur, Tamworth House, Tennyson Road, King's
 Lynn
 1921 Hoare Miss Marjorie, 17, Camberley Road, Norwich
 1919 Horsfall Charles, Stody Lodge, Melton Constable, Norfolk
 1925 Hose Dr. C., F.R.G.S., "Redleaf," Riddlesdown Road, Purley,
 Surrey
 1919 Howard Miss D. D., West Parade, Norwich
 1919 Howard H. J., 6, College Road, Norwich
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 1923 Hunter Miss E. M., Mattishall Hall, East Dereham
 1923 Hunter H. M., Mattishall Hall, East Dereham
 1899 Hurrell H., 25, Regent Street, Gt. Yarmouth
 1915 Hutchinson Donald, M.D., 2, Gordon Road, Lowestoft

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- 1921 Jarrold T. H. C., Pine Banks, Thorpe St. Andrew
 1891 Jarrold W. T. F., Thorpe St. Andrew, Norwich
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 1926 Jolly Lt. B., Aylmerton Hall, Norfolk
 1923 Jolly T. L., Manor House, Worstead
 1885 Jones Sir Lawrence, Bart., 39, Harrington Gardens, London,
 S.W., 7.
 1926 Jourdain Rev. F. C. R., Laverstock, 13, Belle View Road,
 Southbourne, Bournemouth

K

- 1926 Keith E. C., Swanton Morley House, East Dereham
 1927 Kendall O. D., Dept. of Geography, University of Bristol
 1897 Kerrison Colonel E. R. A., C.M.G., D.L., Burgh Hall,
 Aylsham, Norfolk
 1925 Kerrison Mrs., Burgh Hall, Aylham, Norfolk
 1912 Ketton-Cremer W. C., Felbrigg Hall, Norfolk
 1926 Kimberly Mrs., M.Sc., "Constantia," 111n Grove Lane, Norwich
 1904 Kinder Rev. E. H., Kirby Bedon Rectory, Norfolk
 1898 Knight Edward, Keswick Old Hall, Norwich

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- 1925 Labonchere P., The Lodge, Burnham Thorpe, King's Lynn
 1926 Lane D. H., Framingham Pigot, Norwich
 1918 Lascelles Miss Susan, Swanton Novers, Norfolk
 1869 o.m. Laurence Rev. Canon J. A., Dilham Rectory, Norwich
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 1921 le Strange C., Hunstanton Hall
 1909 Leicester The Right Hon. the Earl of, G.C.V.O., C.M.G., V.P.,
 Holkham
 1899 Leney F., Castle Museum, Norwich
 1923 Lipscomb R., Hannington House, Fakenham
 1923 Lipscomb Mrs., Hannington House, Fakenham
 1927 Lister Dr. S. R., Terrington Lodge, King's Lynn

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- 1924 Little J. E., 19, The Avenue, Hitchin
 1923 Livesay Surg. Cap. R.N., St. Andrew's Hospital, Thorpe,
 Norwich
 1922 Livesay Mrs., St. Andrew's Hospital, Thorpe St. Andrew
 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. Sec.*, 31, Surrey Street,
 Norwich
 1907 Long Mrs. S. H., 31, Surrey Street, Norwich
 1919 *Long Miss E. M., 31, Surrey Street, Norwich
 1924 Long Miss M., 10, The Close, Norwich
 1923 Long G. S. B., St. Giles Plain, Norwich
 1921 Lucas The Baroness, Horsey Hall, Great Yarmouth
 1925 Luddington Miss, Wallington Hall, King's Lynn
 1925 Luddington Mrs., Wallington Hall, King's Lynn

M

- 1924 MacKenzie Miss G., The Cottage, Ingworth, Norwich
 1923 Mackie, Mrs., The Red Cottage, Bergh Apton, Norwich
 1923 *Macpherson A. Holte, 21, Campden Hill Square, Kensington, W.8
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 1923 Moxham M. C., Aldborough, Norwich
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N

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 1926 Nevill Mrs. R. W.
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P

- 1889 Page G. W., Walsingham, Norfolk
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 1925 Parker Miss Molly Hyde, Smeetham Hall, Sudbury, Suffolk
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 1873 Partridge Rev. W. H., M.A., "Breccles", Sandown, I. of W.
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 1889 Patterson Arthur H., *Hon. Mem.*, Ibis House, Lichfield
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 1920 Patteson Mrs. F. E., Great Hautbois House, Norfolk
 1901 *Paul J. J. Dawson, Eaton Grove, Norwich
 1911 *Payler Donald, Castle Museum, Norwich
 1926 Payne T. P. H., Rede Rectory, Bury St. Edmund's
 1923 Peed John, Aylsham
 1926 Percy Lord William, Catfield Hall, Norwich
 1903 Petre Col. B., Westwick Hall, Norfolk
 1925 Petrie Mrs., The Dower House, Heydon, Norwich
 1926 Phillippo G., 7, St. Philip's Road, Norwich
 1925 Pilch R. G., 45, Grosvenor Road, Norwich
 1923 Pope Dr. G. Stevens, Heigham Hall, Norwich
 1880 Preston A. W., F.R.Met.Soc., Christ Church Lodge, Norwich
 1919 Preston Sir E., Bart., Beeston Hall, Norwich
 1900 Preston F., Thorpe Mansions, Norwich
 1913 Purdy T. W., Woodgate, Aylsham
 1925 Purnell Mrs. Ralph, 9, The Crescent, Norwich
 1925 Purnell Ralph, 9, The Crescent, Norwich
 1887 Pycraft W. P., A.L.S., F.Z.S., British Museum (Natural History),
 London, S.W.

R

- 1925 Reeves Hugh, Honingham Hall, Norwich
 1924 Richmond H. W., F.R.S., King's College, Cambridge
 1925 Ringrose B., Wilford Rise, Bromeswell Heath, Woodbridge
 1924 Rippingall Neale F., Crabbe, Weighton S.O., Norfolk
 1911 Rising A. P., The Manor House, Ormesby, Great Yarmouth
 1908 Riviere B. B., F.R.C.S., F.Z.S., M.B.O.U., Hill House,
 Saxlingham, Norwich
 1869 o.m. Robinson H. S., Eaton, Norwich
 1908 Rogers Commander F. S., R.N., Ingham New Hall, Norwich
 1909 Rogers Rev. Henry, Colishall Hill, Norwich
 1884 *Rosebery The Right Hon. the Earl of, K.G., 38, Berkeley
 Square, W. 1.
 1908 *Rothermere Rt. Hon. Lord, Hemsted Park, Cranbrook, Kent
 1897 *Rothschild Rt. Hon. Lord, F.Z.S., Tring, Herts.
 1922 Rounce G. H., The Pines, Park Road, Cromer
 1879 Royal Microscopical Society, President of the, *Hon. Mem.*,
 20, Hanover Square, W.
 1918 Rudd A. J., F.Z.S., Queen Street, Norwich

Elected

- 1902 *Ruggles-Brice Mrs. R., Dar-es-Salaam, East Africa
 1906 Rumbelow P. E., 27, Rodney Road, Great Yarmouth
 1919 Russwurm Mrs., Scarning Grange, E. Dereham
 1901 Rye Walter, 66, Clarendon Road, Norwich

S

- 1925 Savill A., Dilham, Norwich
 1925 Sewell P. E., Dudwick House, Buxton, Norwich
 1925 Sexton K. F., 156, Newmarket Road, Norwich
 1922 Shephard Dr. Samuel, Aylsham
 1924 Shepherd Miss A. M., Convalescent Home, Lowestoft
 1926 Shields, A. A., "Greenholm," St. Clement's Hill, Norwich
 1921 Silcock Chas., 56, Southwark Bridge Road, London, S.E.1.
 1919 Simpson F. T., Sheringham, Norfolk
 1926 Slater, B. M., "Bassenhill," Corton, Lowestoft
 1917 Smalley F. W., "Hawthorns," 193, Clapham Road, S.W. 9
 1919 Smith Col. H. F., Diddington Hall, Norfolk
 1915 Smith Mrs., Ellingham Hall, Bungay
 1891 Smith W. R., Harleston, Norfolk
 1909 Snow T., The Craig, Windermere
 1917 Sowels Miss, Thetford
 1911 Spurrell J. T., Manor House, Newton St. Faiths, Norwich
 1923 Spurrell Miss M., Manor House, Newton St. Faiths, Norwich
 1923 Spurrell Miss P., Manor House, Newton St. Faiths, Norwich
 1927 Stanton Hon. J., Cawston Manor, Norwich
 1922 Spalding G., 9, St Stephen's Street, Norwich
 1925 Steers J. A., St. Catharine's College, Cambridge
 1921 Stimpson Edward, Sall Moor Hall, Keepeham, Norfolk
 1922 Sumpter Dr. B. G., Brancaster Staithe, King's Lynn
 1896 Sutton W. Lincolne, F.I.C., Eaton, Norwich

T

- 1921 Taylor Dr. Mark R., 49, Mount Pleasant, Norwich
 1921 Taylor Mrs. Mark, 49, Mount Pleasant, Norwich
 1878 Taylor Shephard T., M.B., The Mount, Edgefield, Melton
 Constable
 1921 Thain D., West Somerton, Norfolk
 1886 Thouless H. J., "Corfe," College Road, Norwich
 1924 Thursby-Pelham Miss D., Fisheries Laboratory, Lowestoft
 1910 Ticehurst C. B., M.B.O.U., 46, London Road, N. Lowestoft
 1896 Tillett Wilfrid S., 2, Claremont Road, Norwich
 1920 Todd Lt.-Col. Eardley, Mundham House, Brooke
 1902 Todd R. A., B.Sc., Fisheries Office, Princess Square, Plymouth
 1913 Tomes Sir Chas., LL.D., F.R.S., Mannington Hall, Norfolk
 1923 Tomes Lady, Mannington Hall, Norfolk
 1923 Torbell C. J., 11, Essex Street, Norwich
 1910 Tracy N 3 King Street, King's Lynn
 1925 Tucker B. W., 3, Park Crescent, Oxford
 1906 Turner Miss E. L., F.Z.S., H.M.B.O.U., 13, Storey's Way,
 Cambridge

U

- 1923 Upcher Rev. E. C. S., Great Dunham Rectory, Norfolk
 1921 Upcher H. E. S., The Gables, Upper Sheringham

V

- 1880 Vaughan Matthew, The Limes, Marlborough
 1917 Vincent James, Hickling, Norfolk

W

- 1921 Wallis Rev. M. C., The Vicarage, St. Faiths
 1923 Walter Mrs. Cyril, Old House, Drayton, Norwich
 1921 Walton Miss, 17, Camberley Road, Norwich

Elected

1923	Waterfield Miss, Attlebridge, Norfolk
1923	Waterfield Miss Penelope, Attlebridge, Norfolk
1926	Wemys Major, "Bryn coed," Wroxham
1927	Wemys Mrs.
1923	Wenn Mrs., Ingham, Norfolk
1923	Wenn Miss, Ingham, Norfolk
1883	*Whitaker Joseph, F.Z.S., Rainworth Lodge, Mansfield
1901	Wild Edward, The Hawthorns, Eaton, Norwich
1922	Willet W. L., The Rosary, Metfield, Kent
1913	Williams Miss Margaret, 28, The Close, Norwich
1909	Witherby H. F., M.B.E., F.Z.S., 326, High Holborn, W.C.
1924	Wolsey Noel G., 15, King Street, Great Yarmouth
1923	Woolsey G. E. W., Old Catton, Norwich
1907	Wormald Hugh, M.B.O.U., Heathfield, East Dereham
1922	Wortley Francis, "Congham," Sheringham
1924	Wright B. D. Z., Hoveton St. John, Norwich
1920	Wyllys Hugh, "Shrublands," Southtown, Great Yarmouth

Y

1923	Young The Right Honble. Sir E. Hilton, D.S.O., P.C., M.P., 174, Buckingham Palace Road, S.W.
1915	Yarmouth Free Library, The, Great Yarmouth

TOTAL

Honorary Members	...	...	7
Life	..	...	34
Ordinary	..	...	382

			423

JUNIOR BRANCH

Barclay Miss H., Tittleshall Rectory, King's Lynn
 Barclay Miss P., The Warren, Cromer
 Barclay Peter, The Warren, Cromer
 Barclay Thomas, The Warren, Cromer
 Barrett Reginald, 12, Beatrice Road, Thorpe Hamlet
 Barry Miss E., Great Witchingham Hall, Norwich
 Barry Miss N., Great Witchingham Hall, Norwich
 Chamberlain Miss J., Witton Rectory, Norwich
 Citters Miss W. van, Wroxham, Norwich
 Cole Miss R., Sprowston, Norwich
 Cole A. L. F., Sprowston, Norwich
 Ferrier Miss J. M., Hemsby Hall, Great Yarmouth
 Gurney O. R., Ingham Old Hall, Norwich
 Hyslop Gordon, Home Farm, Costessey, Norwich
 Lascelles Miss S., Swanton Novers, Melton Constable
 Long Miss E., 31, Surrey Street, Norwich
 Morrison Miss E., Barmer Hall, King's Lynn
 Morse Miss R., Earham Lodge, Norwich
 Parker Miss P., Marlingford, Norwich
 Upcher Miss, Dunham Rectory, King's Lynn
 Upcher Miss R., Dunham Rectory, King's Lynn
 Walter Miss E., Drayton Old House, Norwich
 Waterfield Miss B., *Hon. Sec.*, Attlebridge, Norwich
 Waterfield Miss Penelope, Attlebridge, Norwich
 Waterfield, Miss Philida, Attlebridge, Norwich
 Wathen R., Bolwick, Marsham, Norwich
 Wathen M., Bolwick, Marsham, Norwich
 Winch Miss D., Swanington Court, Norwich

The Treasurer in Account with the Norfolk and Norwich Naturalists' Society, Year Ending April, 1927

I. GENERAL ACCOUNT

	DR.			CR.				
		£	s.	d.	£	s.	d.	
1926-27.								
To Balance on Deposit	...	67	9	10	...	131	4	6
" Current Account	...	38	13	6	...	6	6	0
" Subscriptions	...	163	3	0	...	8	2	6
" Sale of "Transactions"	11	6	3
" Sale of "Flora of Norfolk"	8	12	10
" Special Publication Fund	4	17	2
" Payment by W. B. P. F.	0	13	6
" Interest on War Stock	13	15	7
" Interest on Deposit a/c	119	6	2
		304	4	6		304	4	6

Examined and found Correct,
W. A. NICHOLSON,
April 25, 1927

ADDRESS

Read by the President, E. HANBURY HANKIN, M.A., Sc.D., to the members of the Norfolk and Norwich Naturalists' Society, at their Fifty-Eighth Annual Meeting, held at the Norwich Castle Museum, on April 26th, 1927.

LADIES AND GENTLEMEN,

THE membership of the Society still continues to increase, twenty-five new members having been elected during the year, and we now have well over four hundred members.

At our monthly meetings some very interesting papers have been read, one of these being a lantern lecture on the birds of the Broadland District by Mr. Jim Vincent of Hickling. The Bird Watchers employed by the Society were present at this lecture.

The Society has lost by death two old and valued members, Sir Digby Pigott and Mr. Frederick Long. Obituary notices will appear in the next issue of our Transactions.

It is greatly to be regretted that the Committee has been unable to find anyone willing to accept the duties of Excursion Secretary. These excursions are greatly appreciated, but unless someone will come forward and undertake their organization, they cannot be carried through.

For my Address I have chosen an astronomical subject ;

THE PROBLEM OF MARS

CHANGES, partly seasonal, in colour and shape of certain markings on the planet Mars appear to leave no room for doubt that some form of life is there present. We know so little as to what are the fundamental and necessary characters of living beings that there is but little justification for using the analogy of life on earth in forming conceptions of the possible forms of life on Mars. From this point of view many statements made by astronomers about Martian life are open to criticism.

For instance, Pickering, one of the most distinguished and persevering of the observers of Mars, having satisfied himself that the Martian atmosphere contains oxygen up to 15 per cent. of our own, goes on to say " It is therefore clear that animal

life, which had developed increased lung capacity, may readily exist on Mars." This may be admitted, but what is open to criticism is his apparent inference that animals on Mars, if animals there exist, have lungs. We have lungs because we are descended from fishes whose swim-bladder has gradually been modified to subserve terrestrial respiration. The great majority of air-breathing organisms on the earth, apart from those of microscopic size, are provided with minute branching tubes that carry oxygen directly to the tissues. It is just as possible that Martian animals, if such exist and if air-breathing, are provided with tracheæ or some other aerating mechanism rather than with anything resembling lungs.

But what right has Pickering, Lowell, and other astronomers to assert that animal life exists on Mars? If the facts of observation justify us in believing that intelligent life is present on that planet, why should not this intelligence reside in living beings having locomotive powers and sense organs but depending on chlorophyll for their nutrition? On the earth the larger forms of life fall naturally into two classes, those that take liquid and gaseous food that we know as vegetables and those that, broadly speaking, eat solid food and that we know as animals. If we knew the secrets of the metabolism of the smaller forms of terrestrial life, it is possible that we should find among them some differing from animals and vegetables as much as animals and vegetables do from each other. How can we venture to assert that living beings on Mars must be of such a nature that they can be classified in the same way? What right have we to argue from terrestrial analogy that intelligent beings on Mars can only be found among parasites on the vegetable world provided with a mouth through which they take in solid food?

If Martians have the power of reproduction—and if they use it—it seems inevitable that they must compete with one another for the physical necessities of life such as water, air and space. But we have no more right to assume that their competition involves preying on one another than we have to assume that they have sexual reproduction.

Life as we know it on the earth is originally and naturally immortal. This is the case at the present day with microscopic organisms consisting of single cells which, as they grow older,

do not die but divide forming new individuals. The higher plants and animals consist of colonies of cells, of which cells only a few retain primitive immortality and develop into offspring. The others, which we recognize as the body of the individual plant or animal, are condemned by nature to death when they have performed their function of guarding and nourishing the germ cells. Thus the body of an animal corresponds to the cyst of an amœba which is likewise destined to perish when it has performed its function of guarding the germ cells till they are ready to carry on an independent life. This rule is universal among the more efficient living beings on earth, but what right have we to assume that this complicated device exists with the inhabitants of Mars? It might be answered that probably life of a high degree of complexity is present on Mars and that such life could not have come into existence unless some perished while others, the fittest, survived. To this it may be replied that if individuals on Mars are immortal they may be constantly improving by elimination of the less fit parts of their bodies. If this were so each individual would be the repository of experience which would be maintained and might be used far more efficiently than can be the case on earth where, at frequent intervals, acquired experience, taking the form of instincts, has to be squeezed into and transmitted through the germ cells. We know so little of the fundamental properties of living matter that, in the present state of our knowledge, we are unable to exclude this possibility. Neither can we, on *a priori* grounds, exclude the idea that Martian life exists in the form of a single gigantic and immortal vegetable whose strands we see encircling the planet as the so-called canals. We have no right to condemn such a suggestion because it strikes us as highly improbable. We must discard it on the safer ground that it seems to be incompatible with certain known facts of observation about to be described.

It is asserted by astronomers that not only life but also intelligence of a high degree exists on Mars. Foremost among the observers of Mars is the American astronomer Lowell. It is unfortunate that he has expressed his opinions on this point with a dogmatism of a kind likely to arouse opposition. In dealing with a skilled observer it is necessary to distinguish

between what he sees and what he thinks about what he sees. We must not allow our distrust of his sensational conclusions and his obviously too confident use of terrestrial analogy to lead us to disregard the many remarkable facts he has discovered. Let us first quote some of his statements. He says that the observer of Mars "stands confronted with the workings of an intelligence akin to and therefore appealing to his own." "Not only does one species possess the planet, but even its subdivisions must labour harmoniously to a common aim. Nations must have sunk their local patriotism in a wider breadth of view." "The first thing that is forced on us in conclusion is the necessarily intelligent and non-belligose character of the community which could act thus as a unit throughout its globe." Referring to the Martian summer being longer than our own, he says "This lengthening of the period of reproduction cannot but have an elevating effect upon the organism akin to the prolongation of childhood pointed out by John Fiske as playing so important a part in the evolution of the highest animals." Perhaps the most singular of his conclusions is this, "In our exposition of what we have gleaned about Mars, we have been careful to indulge in no speculation."

On the earth the evolution of a high degree of intelligence is but an affair of yesterday. It is by singular and puzzling chances that that somewhat grotesque product of evolution the anthropoid ape has evolved into *Homo sapiens*. Man stands alone among the myriads of species of living beings that exist or that have existed on the earth in having a high degree of intelligence. Thus on the earth the production of intelligence is a rare phenomenon. If there is an analogy between Martian and terrestrial life, as is assumed by Lowell and other astronomers, then we must regard the idea of Martian intelligence with a very great degree of scepticism and, before accepting it, must demand the most rigorous and exhaustive proofs.

If, on the other hand, the nature of living beings on the planet Mars is entirely different from what we are acquainted with on our globe, if from their nature they are endowed with a capacity for storing and using experience of a kind entirely different from that possessed by terrestrial life, and if the

Martians are engaged in a common fight against the conditions of their environment rather than in devising means of killing and eating one another, then the idea of Martian intelligence may appear less improbable, while, at the same time, we are the less justified in using terrestrial analogy in guiding our beliefs.

Having thus emphasized the need for caution in forming any opinion as to the nature of life on Mars, let us proceed to review briefly the known facts of the case.

Discoveries made in recent years indicate that the conditions on Mars are not so incompatible with life of the terrestrial pattern as was once believed. Owing to its great distance from the sun, Mars must receive much less heat than does the earth. It was therefore inferred that its temperature must always be far below that of the freezing point of water. The polar caps of Mars, which melt in the Martian spring, were explained by the supposition that they consisted of frozen carbonic acid. But this belief overlooked the effect of the scarcity of water on Mars. Lowell has calculated that Mars possesses 189,000 times less water than does the earth. Its atmosphere, in consequence, is much drier than ours. Water vapour dissolved in the air has a great power of stopping solar heat rays. Without this protecting vapour the earth, where exposed to sunshine, would be very much hotter than it is. Dryness of the Martian atmosphere is consequently a condition that permits heat from the sun to reach the surface of that planet. Hence it is not very surprising that actual measurements, by delicate thermopiles, have yielded reasons for believing that the temperature of the brightly illuminated surface of Mars is not unlike that of a cool bright day on the earth with temperature ranging from 45° to 65° F. So delicate was the apparatus employed in this research by Coblentz and Lampland* that it was possible to measure the radiation not only of the planet as a whole but also of its different parts. It was found, for instance, that the part illuminated by the afternoon sun is warmer than that exposed to the morning sun, and that the dark areas (which are supposed to be covered with vegetation) are warmer than the desert areas.

**Publications of the Astronomical Society of the Pacific*, Vol. XXXVI., October, 1924, p. 273.

It used to be thought that the atmosphere of Mars is extremely tenuous. The force of gravity on that planet is only about $\frac{3}{8}$ of that on the earth. This lesser force of gravity was taken to imply that Mars has less power of holding and attracting its atmosphere than has the earth. Hence it was supposed that much of its original atmosphere had gradually leaked away into space. Mars was described by Lowell as having lost most of its water in this way and he imagined that its inhabitants were hard put to it to economize the remaining supplies and were facing the prospect of eventual death from thirst. But, according to Pickering, the atmospheric pressure in Mars cannot be widely different from that on the earth. It may even, he says, be denser. One reason for this belief is that clouds on Mars have occasionally been seen rising to the enormous height of 50 to 55 miles above the surface, a phenomenon that affords a proof of the presence of a supporting atmosphere of large extent.

Let us now consider the facts of observation that are supposed to justify the belief that some form of life is present in Mars.

Parts of the planet are of pale reddish to ochre-yellow colour, the tint varying from time to time. These areas, which occupy about $\frac{3}{5}$ of the surface are supposed to be deserts.

Other parts of the planet are of darker tint and were once supposed to be seas. They are now believed to be more or less dry land, probably lying at a lower level than the deserts. They show colour changes which suggest that they support some kind of vegetation. In the Martian spring these areas have either a pale green or a greyish colour. During the summer the tint deepens to darker green, bluish-green or blue. In the autumn the colour changes to brown, yellow, or grey. Lowell, believing that the green colour is due to vegetation, explains the blueness as due to the effect of haze, such as sometimes on the earth causes vegetation on distant mountains to assume a bluish tint. Pickering, on the other hand, adduces facts that do not agree with this explanation. A dark area known as the *Mare Acidalium* first appears as a greyish marking in the spring as the north polar cap melts. Later it turns blue and retains this colour for several months. Another dark area, the *Syrtis major*, he says, may turn blue but it never

retains this colour for more than a few days at a time. He denies that the blue colour is due to water and asserts that it is due to some form of vegetation.

These curious observations at once suggest a number of questions. For instance, how often does the *Syrtis major* turn blue? Does this happen once or several times during the Martian summer? As regards the autumnal colour-changes to either brown, yellow, or grey, which, according to Pickering, suggest different kinds of vegetation, does each dark area always assume the same autumnal colour? Or does the same area take on different autumnal tints in different seasons? Are the observers of Mars on the look-out for evidence of rotation of crops, which, if ever it were firmly proved, might give a reason for suspecting intelligent activity?

The change of seasons is far more abrupt on Mars than with us. The turning brown in the autumn of a particular area is described by Pickering as advancing at the rate of three hundred miles a day.

That the above-described colour changes are in fact due to vegetable life is further made probable by their connexion with the melting of the polar caps. It is only as the snow vanishes that the green colour appears and spreads. It seems that on Mars it is the supply of water rather than the warmth from sunshine that determines the coming of spring, for the green colour appears first near the margin of the polar cap, as the snow begins to melt, and spreads thence towards the equator.

The possibility has been suggested that some inorganic substance is present on Mars that has the property of changing colour according to the amount of moisture it contains. In this way the connexion between the colour changes and the melting of the polar caps might be explained without recourse to the hypothesis of the presence of life. This possibility appears to be made improbable by the fact that the extent and shape of the dark areas may vary greatly in different years. For instance, Antoniadi has published drawings of the dark area known as the *Solis lacus* as seen by him in 1924 and again in 1926. On the latter occasion it had altered in shape and extended in a northerly direction over an area nearly as large as France. The further hypothesis that moisture-bearing

winds might travel in different directions in different years seems insufficient to explain the facts, as on each of the two occasions mentioned the *Solis lacus* was surrounded by other dark areas that exhibited no conspicuous changes.

Other dark areas appear to take up different positions in different years or to vanish entirely and reappear after a longer or shorter interval. According to Pickering the north end of *Syrtis major* may shift laterally in position by as much as 183 miles. He is of opinion that the *Syrtis* is a swamp that is flooded by the melting of the two polar caps in turn in each Martian year. The shifting in position of a swamp appears to need some further elucidation. The usually prominent feature known as the *Fastigium Aryn*, from which Martian longitudes are measured, is sometimes invisible and also, according to Pickering, is liable to change its position.

We now pass on to the vexed question of the celebrated canals on Mars. In the first place it may be stated that those who deny the presence of band-like or linear markings on the surface of the planet show themselves unacquainted with the evidence that has now accumulated. There can be no doubt whatever that such markings are visible to all competent observers when the planet is viewed under suitable conditions. Pickering says : " Given the proper conditions, almost anyone can see the coarser canals at the first glance, and after five or ten minutes' study will see most of the fainter ones."* The needful conditions however seem only to exist at certain observatories. Pickering was unable to see the canals at Cambridge in the United States. Antoniadi, whose observatory is situated at Meudon in France, is quoted as saying ; " We affirm in the most categorical fashion that no intricate system of fine lines exists on Mars." It may be suggested that it would have been safer for him to say that he himself had failed to see such lines. Very clear evidence exists that observations made at his observatories are less satisfactory than those made by many other astronomers.†

* *Publications of the Astronomical Society of the Pacific*, Vol. XXX., October, 1918, p. 299.

† Compare, for instance, his drawings of the region of the *Solis lacus* with that made by Pickering (" Monthly Report on Mars " in *Popular Astronomy*, Vol. XXXIV," p. 149). See also E. C. Slipher, *Popular Astronomy*, Vol. XXXII., No. 9, November, 1924, p. 2. " Observations of Mars in 1924 at the Lowell Observatory."

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Fig. 1
Pickering 358 A



Fig. 2
Hamilton 1 A



Fig. 5
Pickering 60 B



Fig. 6
Hamilton 67 B



Fig. 9
Pickering 118 C



Fig. 10
Hamilton 122 C

Examples of drawings of Mars by different observers.
From Popular Astronomy, Vol. 34.

Pickering has performed a great service by forming an association of observers of Mars who, from different parts of the world including Arizona, Japan and Ceylon, have sent him numerous drawings of the planet as seen by them under different aspects. He has reproduced a number of these drawings in his Reports on Mars published in several volumes of *Popular Astronomy*. Some of these from Vol. XXXIV. are shown in Plate XX. The similarity of the drawings made by different observers thus shown is striking. The drawings by Trumpler are of interest in that he had made no previous study of the topography of Mars; but yet his drawings closely resemble those made by other observers and also include some small canals that had been overlooked by others but that had been seen by Professor Lowell many years previously. Referring again to Plate XX, it may be noted that certain canals which are seen by Pickering as bands of appreciable width, appear to Hamilton as fine lines. This differing appearance of the canals to different observers is rather puzzling. On this point Pickering says:—"When the writer erected the first dome and 18-inch telescope at the Lowell Observatory in 1894, he and Professor Douglas saw the canals exactly as they see them now, as grey markings of appreciable breadth, while Professor Lowell saw them always as fine lines. It is clearly then a question of personality."*

Scepticism as to the existence of the canals has been supposed to be justified by the asserted impossibility of photographing them. But they are shown, though imperfectly, in some of the more recent photographs. Great technical difficulties are met with in obtaining such photographs. Special colour filters, specially prepared plates, a short exposure of from $1\frac{1}{2}$ to $2\frac{1}{2}$ seconds, are required. Much of the detail thus obtained is lost when the photographs are reproduced for a magazine article. But it is movements of the terrestrial atmosphere that are the chief obstacle to securing sharpness of delineation of such details as the Martian canals. Hence large numbers of photographs have to be taken in the hope of catching the planet at moments of best definition. Examples of such photographs are shown in Plate XXI. They were taken in connection

*" Monthly Report on Mars," *Popular Astronomy*, Vol. XXIII., p. 220.

with an appearance of haze that obscured the *Syrtis major* in the mornings and evenings during a couple of months. In this illustration, between the photographs, a drawing of the planet on a slightly larger scale is inserted. Comparing this drawing to the face of a clock, at the position corresponding to 2 o'clock, a whitish area is visible which hides all except the northern end (the lowest in the photograph) of the *Syrtis major*. The north polar cap is shown on the lower margin of the drawing. These features, and also an indication of some of the more conspicuous canals, can be made out on the photographs.*

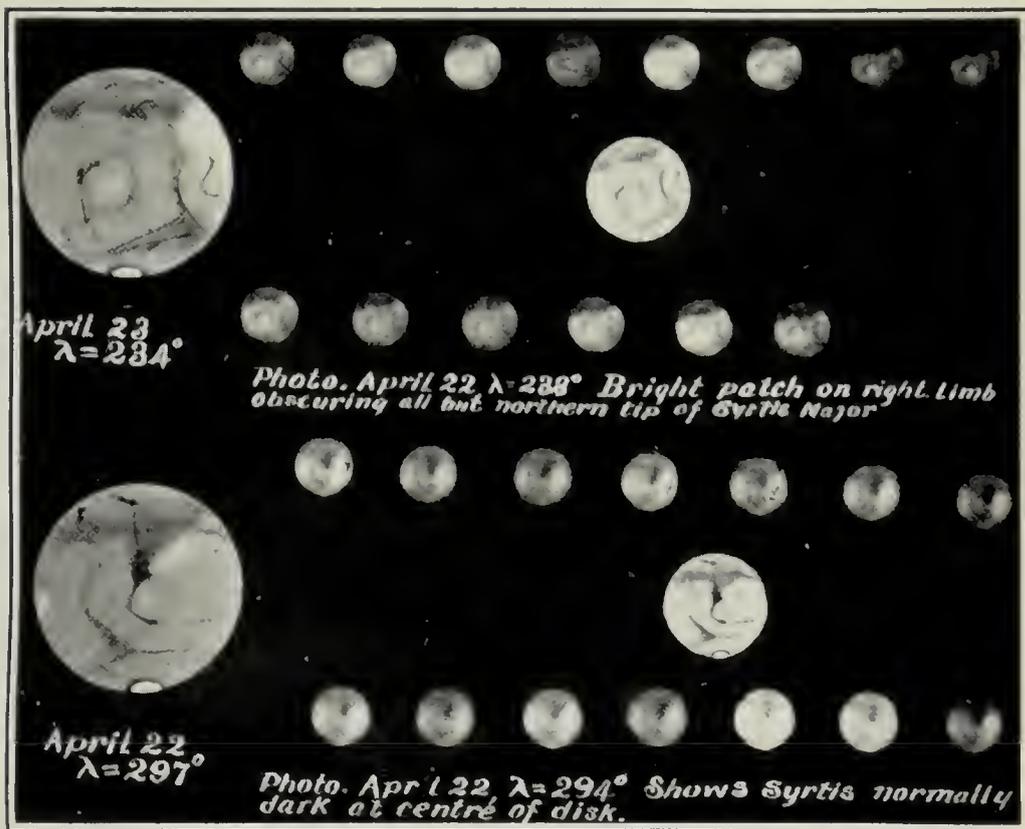
Admitting that the canals exist, the next question to interest us is their possible nature.

Whether, as asserted by Lowell, they are from two to thirty miles wide, or whether, as believed by Pickering, their width varies from 100 to 250 miles, there is no room for doubt that what is seen is not irrigation channels of water of such sizes

It has been suggested that what is seen is a belt of vegetation bordering a channel of reasonable size along which flows water derived from the polar snows. Against this idea may be pointed out the fact that sometimes the larger canals cross one another either at right angles or at smaller angles as if they were entirely independent structures. Sometimes these intersections are marked by small dark spots, known as oases, whose size is estimated by Lowell as being from fifteen to one hundred miles in diameter. They fade out of sight on the approach of the Martian winter at the same time as do the canals that enter them. During this process occasionally the centre of the oasis fades first. Lowell adduces their circular shape as a proof that they are the product of intelligent action, a deduction, it may be suggested, of very questionable value.

The canals often run in a straight line for such distances as 2,000 to 2,500 miles. This straightness has been adduced by Lowell as a proof that they are due to an intelligence "akin to our own." This argument is the reverse of conclusive, as canals designed by human intelligence would pay some attention to the

*E. C. Slipher, "Photographing the planets with special reference to Mars," *Publications of the Astronomical Society of the Pacific*, No. 193, June, 1921, p. 1, and "Obscuration of the Martian Syrtis Major," *Popular Astronomy*, Vol. XXIX., No. 2, February, 1921, p. 1.



Photographs of Mars by Slipher.

Enlarged drawings of the Planet are inserted for comparison.

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contours of the country. Though observations make it probable that no mountains and no elevations of more than two or three thousand feet exist on the desert surfaces of Mars, it is difficult to believe that these areas are so absolutely flat as to justify the straightness of irrigation channels running across them. Lowell asserts that the dark areas of the southern hemisphere are at a lower level than the deserts. According to Pickering, this difference of level may amount to as much as 8,100 feet.* Nevertheless, certain canals run through the dark areas and up hill on to the deserts in the same straight line as if there was no obstruction to their course. No doubt the straightness of the canals *may* be the result of intelligent action, but the safer inference would be that the phenomena of Mars are quite inexplicable at the present time.

One curious observation may now be mentioned which, if substantiated, may be regarded as affording a slight presumption that the canals are indications of an irrigation system. Some of the canals occasionally appear to be double. On careful examination the canal is seen to consist of two faint lines running parallel to each other and lying at a distance from each other of from 75 to 200 miles. Out of 437 canals observed by Lowell, 51 have been seen double. According to Pickering this doubling has been seen occasionally by nearly every observer. Of such twinned canals one member is occasionally weaker than the other. It is always the same one of the pair that weakens with two exceptions. These are of twinned canals having approximately a north and south course. In each of these instances, one member of the pair is fainter when the canal is fed by melting of the north polar cap and the other when the canal is fed from the south polar cap.†

On the irrigation theory an explanation may be offered, or rather a curious deduction may be drawn, from this anomaly. If, in a tropical country, irrigation without drainage is continued for a long time, then, as water evaporates from the irrigated surface, the salts contained in it are left behind. These gradually accumulate in the soil, at length rendering it sterile. Hence irrigation to be successful must be combined with

*" Monthly Report on Mars, No. 5," *Popular Astronomy*, Vol. XXII., p.295.

† *Nature*, April 27th, 1909, p. 260.

drainage. The alternate weakening of each member of the twinned canals thus suggests that, of the pair, one is used for irrigation and the other for drainage and that, as the source of their water changes, they reverse these functions. Obviously this suggestion is not one on which much weight can be laid in the present state of our knowledge.

A reference to salts dissolved in the water on Mars occurs in another connection. Lowell described white spots as occasionally appearing on the desert areas of Mars. He satisfied himself that they were not due to cloud. They last for weeks or even months. They occur chiefly in the north tropic belt and the most striking spots are found to the west of large dark areas. Lowell thought they were deposits of hoar frost. But since Lowell's time, evidence has accumulated that the surface temperature of Mars, away from the poles and in summer, is far above what would permit hoar frost to persist for so long. In reply to a question from me, Professor Slipher, the present Director of the Lowell Observatory, informs me, with commendable caution, that the idea that these spots might be deposits of salts left by the evaporation of water has been considered and that this idea, as an explanation, "would probably now seem to be more satisfactory than some years ago." In India the evaporation of water sufficient to make a visible deposit—the so-called "reh" soil—is a matter of months or years. But the white spots on Mars seem to appear suddenly. It is in accordance with mundane analogy that the water in a canal should be at a higher level than the land it is about to irrigate. Are we then to imagine that a canal has burst its banks and flooded an area of several hundred miles in diameter and that the water was so impregnated with salts that, at once, on its evaporation, a visible crystalline deposit was formed? Or was the flood a voluntary excretion of some waste product? Is an area on which a white spot has developed immune from the appearance of white spots in future, and if so, for how long? One infers from Lowell's description that these white spots disappear somewhat suddenly. Why do they disappear if they are alkali salts? Are they blown away by wind or are they covered with desert dust? It seems probable that many years of observation will be needed before we can expect answers to even such simple questions.

Pickering has made various suggestions as to the possible nature of Martian canals that do very much credit to his imagination.

The great difficulty in accepting the view that the canals contain irrigation channels is the enormous power that would be needed to pump water along them. It has been estimated at the rather fantastic figure of 2,500,000,000 horse power.* Pickering attempts to get round this difficulty by suggesting that the transport of water on Mars is by aerial routes partly along the course of what we see as canals. He considers that the Martian canals are of two kinds: (1) Temporary, which never turn green and which are due to the effect of dampness changing the colour of the soil; and (2) Canals, which in the summer season turn green and which may be regarded as due to vegetation.

For instance, the canal *Amenthes*, which had disappeared, in 1911, reappeared in 1921. It was seen on a particular occasion but "two hours later," he says, "on this same date, when on the central meridian, it could not be found although carefully looked for. This illustrates how ephemeral even well-marked tropical canals may sometimes be. No Martian clouds were visible in this place at this time. This observation tends to confirm our belief that some of the Martian canals are at times merely shower tracks which under a hot tropical sun dry up."†

He lays stress on the fact that in the terrestrial tropics, a shower having sharply defined limits at either side may proceed for several miles in a straight line. The genesis of such showers is well understood by meteorologists, and it may be confidently asserted that there would be very great difficulty in understanding how a shower could travel for a thousand miles or more on the planet Mars unless some unknown factors are at work there quite unlike anything known on earth.

The most singular, and perhaps the most attractive of Pickering's suggestions is based on his discovery of two broad greyish bands each running in a NS direction from near the

* C. F. Horsden in *The Riddle of Mars the Planet*.

† *Popular Astronomy*, Vol. XXXIII., p. 434.

polar cap to the southern dark areas.* He has seen them on three successive oppositions of the planet. He describes them as lasting about a month and varying rapidly in size, widening in one case to 1,200 miles. He says that the band bordering the melting polar cap, which is believed to be of water, was narrowest when following, i.e., to the west of the beginning of each of these bands, as if the latter drained the former of its water. He regards these bands as indicating a transference of water by an aerial route and also as a proof of intelligent activity.

He has also made the suggestion that rain may be caused to fall where it is wanted on Mars by the discharge of electrons. On the earth we have insects, bacteria, and protozoa that give out light, animals that give out heat, fishes such as the torpedo that give out electric shocks. Is it beyond the possibilities of nature for Martian vegetables to emit electrons, or must Pickering's supposed electrons be due to machinery worked by intelligent beings?

Lastly, we may mention Pickering's assertion that certain of the canals have been seen to shift laterally. Of two canals, *Gigas* and *Tartarus*, he says that they "apparently travelled some three hundred miles across country in about three weeks, that is, at a speed of fifteen miles a day. In that time they traversed their full breath." An attempt has been made to explain such apparent shifts by the assertion that these were double canals of which one member was seen at one time and the other member at another time. Pickering's answer to this criticism seems convincing to the non-expert, but I am not aware whether other astronomers accept his views on this point. (*Popular Astronomy*, Vol. XXIII., p. 227.)

* "Monthly Report on Mars, No. 11," *Popular Astronomy*, Vol. XXIV., p. 569.

II

A PORTUGUESE SAND DUNE

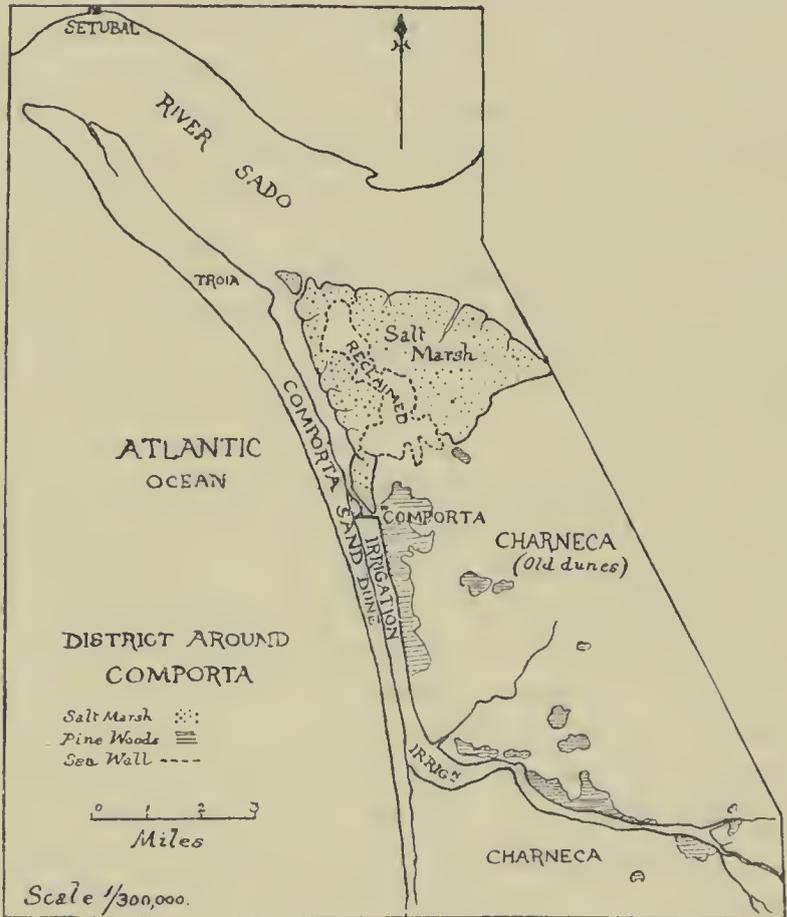
BY F. W. OLIVER, F.R.S.

ON ENGLISH SAND DUNES

SANDHILLS which go by the name of *dunes* are distinguished by the fact that they are created and moulded by the wind, also destroyed by the same agency. In the case of maritime dunes the materials of which they are composed have been blown by onshore winds from the foreshore to a higher level where they are out of reach of ordinary spring tides. The wind is the active agent of transport, whilst the plants which settle on the dunes, or which may even have been present on the terrace of assembly or beach prior to their appearance, tend to collect and hold the sand. This they do in the main by sheltering the surface from the ruder winds, though this stabilising action is doubtless assisted by the diminished evaporation from the surface where the shadows of the plant fall. Later, as humus accumulates through the disintegration of the pioneer plant covering, this added matter tends to hold the sand particles together, to promote chemical action, and at the same time to increase the water capacity of the soil. Plants in this relation are sometimes called "sand binders," and in a general way the term is justified. But the binding depends on the causes just outlined and has no direct connection with the fact that the sand is penetrated everywhere by a plexus of runners and rhizomes. It is the surface which is moved, and this subterranean equipment of the plants is only important in that it enables the sheltering shoots and foliage constantly to emerge at fresh points.

On English sand dunes the first vegetation is especially marram and other grasses, and with further piling up of sand these plants push through and give the surface a partial protection. For at this stage bare sand is visible between the haulms of the grasses, and this sand is stabilised only in so far as the plants act as a wind break. Where plentiful supplies of sand are available the height of the dune will go on rising until the exposure to windage is such that the amount of sand blown away balances that which is brought.

Meanwhile other colonists find their way into the relatively stabilised dune, perennial plants with deep rooting habit, such as *Erodium*, *Senecio Jacobaea*, *Carex arenaria*, and many others. Later, mosses and lichens arrive, often covering the surface very completely, whilst a further feature of most English sand dunes is the settlement of small annual plants, the ephemerals, plants which complete their life histories in



TEXT-FIG. 1. Map of the Comporta district, simplified from a map privately printed. The River Sado, to the south of which Comporta lies, is about 30 miles south of Lisbon.

early spring whilst surface moisture is still available. These, which include forms like *Draba verna*, *Saxifraga tridactylites*, *Cerastium semidecandrum*, etc., constitute a further element of protection, whilst their bodies on dying add to the humus of the soil.

With the increase of humus the dune soil becomes acid, a change which is emphasised by the gradual leaching out

of carbonate of lime derived from broken shell fragments blown up with the sand from the shore. Lime-loving plants are especially characteristic of the earlier, non-acid stage of the dune.

As regards the dimensions of the grains of sand on English dunes, the following figures, being the average of several determinations from the Blakeney Point system, may serve as an example (table, p. 283, last column).

THE COMPORTA SAND DUNE

The subject of the present account is the Comporta sand dune, a mound of sand stretching along the Atlantic shore of Portugal some thirty miles, from Cape Sines to the Bay of Setubal, where the dune ends freely as a headland in the estuary of the Sado, protecting on its east a large area of salt marshes from the Atlantic Ocean. The width of the dune varies from a half to two-thirds of a mile, and its height is from 70 to 80 feet. It consists of a coarse quartz sand, and its colour is a glistening white. Our dune runs from south to north. It slopes up gently from the sea, culminating first in an outer ridge. (A, text fig. 2.)



TEXT-FIG. 2. Diagrammatic profile of the Comporta dune. S. seaward edge; L. Lee side; A and B the seaward and landward ridges. The portions of the surface usually vegetated are indicated by vertical strokes.

From this point the level drops a little and then continues east as a slightly uptilted table land, reaching its greatest height towards B. From this highest ridge the profile falls abruptly (about 32°) as the lee slope, forming the western boundary of the salt marshes and cultivated alluvial ground.

Towards the northern end are the ruins of the Roman Settlement of Troia, and still further north a whaling station. In this region parts of the dune have been fixed by the planting of pines, etc., otherwise its main length is untouched, except for an occasional pine on the lee slope (Pl. XXIV., above). Nor is the dune frequented or otherwise interfered with by the local inhabitants.

Here and there the ridge is crossed from some hamlet for the collection of drift wood or to reach a boat on the shore. The habits of the peasants do not lead them to wander on the dunes for relaxation. One or two fixed slopes on the lee side are used for pasture, but otherwise the dunes are deserted and unspoilt, and the footprints of man are as rare as on Robinson Crusoe's Island.

As regards the travel of the sand: this is derived from the beach, and with much comminuted shell debris is driven up the shoreward slope. The main sloping plateau, much of which is bare, is being eroded by wind, the products finding their way to the lee slope where they rest at the critical angle of the material. The highest ridge, above this slope, is held by a sparing but tenacious vegetation. Irregular in its distribution, this vegetation holds minor ridges transverse to the length of the dune system, which sometimes stretch to join the shoreward slope (as in Pl. XXII.), though more frequently they die out on the plateau. The shoreward ridge is pitted by numerous blow-outs (Pl. XXII.), but its outer and inner slopes are the stronghold of the vegetation.

TEXTURE OF DUNE

As already stated, the materials are coarse (c.f. analysis, p. 283) and this coarseness of texture has several important results. Whilst on the Blakeney dunes about 70 per cent. of the sand is between $\frac{1}{4}$ and $\frac{1}{3}$ mm., at Comporta 86 per cent. exceeds $\frac{1}{2}$ mm., and 42 per cent. ranges from $\frac{3}{4}$ mm. to 2 mm. in diameter.

A first consequence of this coarseness, reinforced by the power of the Portuguese sun, is the great dryness of the dune, especially of its surface layers—a circumstance undoubtedly reflected in the vegetation carried.

A second result is the relative immobility of the bulk of the sand in lighter winds. These, whilst drifting away the smaller particles, leave the larger undisturbed, so that the whole surface of the dune becomes enclosed in a thin mantle of large, immobile sand grains, extending to a thickness of several millimetres. Deeper down, finer material is found with the coarser, but at the surface the finer grains hardly occur at all. In the annexed table are given mechanical analyses of Comporta sand from the surface $\frac{1}{4}$ inch, and from this level down



COMPORTA DUNE PLATEAU WITH SCRUB, LOOKING NORTH

View of plateau of Comporta dune about 4 miles south of Comporta, looking north. The Atlantic Ocean is seen on the left. The vegetation consists of scattered shrubs with bare sand between. They include *Diotis candidissima*, *Helichrysum Stachas*, *Crucianella maritima*, *Lavandula pedunculata*, *Lithospermum fruticosum*, and (on the right) conspicuous bushes of *Corema album*. Across the middle of the picture is a streak of *Triticum junceum*. (April, 1927.)

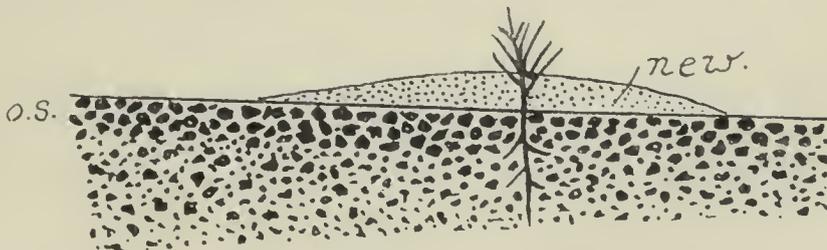
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to 6 ins., expressed as percentages by weight of the whole sample. In the last column are given similar data for the Blakeney Point dunes. In all cases the figures represent the average of three determinations taken at random from different stations.

Size of Grains in mm.	Comporta Dune.			Blakeney Point.
	General Samples 1—6 ins.	Surface ‡ in.	Armeria Dune.	General Samples 1—6 ins.
above 1	8·1	33·7	—	—
1—·7	34·1	48·4	6·0	0·1
·7—·5	43·7	12·0	62·5	1·8
·5—·3	12·0	—	28·0	16·0
·3—·25	2·0	—	3·0	68·9
·25—·2	—	—	—	8·9
below ·2	—	—	—	4·1

Table showing mechanical analyses of Comporta and Blakeney Point dune sands, expressed as percentages by weight. Each column is the average of three determinations from different stations.

Where little new dune eminences arise upon the plateau this property of the sand has a marked effect. Thus on the occasion of one of my visits to Comporta on a certain spot, otherwise bare, shoots of *Armeria pungens* had recently grown out from the surface, and had collected around them a deposit of drifting sand. The grains composing these new dunes were of the smaller grade and contrasted markedly in size with those of the general plateau surface on which they rested (text fig. 3). These little dunes, which were only



TEXT-FIG. 3. Small new dune recently formed around an *Armeria* plant. The sand thus collected is of fine texture and is underlaid by the large grained old surface (O.S.). Deeper down finer grains are mingled with the large ones.

a few inches high, must have been formed from finer, mobile particles drifted out of the general mixture by winds of moderate velocity, which failed to disturb the larger particles. The composition of the sand of these little *Armeria* dunes is given in the fourth column of the table. Very little sand larger than .7 mm. is present. The texture of the surface, and of the underlying sand upon which these *Armeria* dunes rested, corresponded precisely with the figures of columns 3 and 2.

Taking the whole year through this extreme disparity in size must have an appreciable effect in the retardation of the travel of the dune as a whole ; for sand travel of any magnitude will be restricted to the occasions when strong winds and gales are blowing.

Though data are not available for the actual locality, I am indebted to the courtesy of the Meteorological Office (Air Ministry) for the following returns for Lisbon. For the ten years, 1908-1917, the average number of days per annum on which the wind exceeded 15 miles per hour was 79, whilst a velocity of 25 miles per hour was exceeded on 30 days only. The days on which these winds blew are distributed fairly evenly over the year.

It is only when such winds as these are blowing that the finer and coarser sand alike will get into motion, and the mechanism of automatic protection be broken up. With the resumption of calm weather the finer material will be drifted out of the surface, which will once more become reinstated as a protective mantle. The inference drawn is that the mechanism has a quite appreciable stabilizing value.

The actual advance of the lee slope is obviously very slow as compared with dunes of ordinary texture, and no special measures are taken to protect the ground invaded. As much of this is valuable, irrigated ground, complaints would be heard were it being seriously threatened (map, text fig. 1).

Theoretically, all dunes showing disparity of size between their sand particles may be expected to exert a similar action for a certain range of winds, but where the larger grains average less than $\frac{1}{3}$ mm. (as at Blakeney) the protection given against sand drifting in mass would be negligible.

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COMPORTA DUNE, LOOKING SOUTH

View of dune plateau 1 mile north of Comporta, looking south, towards Cape Sines. The seaward side carries the usual open formation of low shrubs of which *Thymus carnosus* is seen in the foreground. On the left is much bare sand, and it is here that the *sand sheaths* are becoming exposed. The grass in the foreground is Marram.
(April, 1927.)

THE VEGETATION

The plants of the Comporta dune are strikingly different from those of our familiar English coast, both in species present and in their manner of distribution, though, apart from ephemeral forms, both northern and southern types agree in the possession of some or other mechanism enabling them to conserve their water supplies. In the case of the Portuguese dune plants these mechanisms are outstanding—as well they may be considering the great insolation to be endured.

The main vegetated areas on the Comporta dune extend (1) from the beach to the crest of the seaward ridge, (2) from this crest down the short slope to the beginning of the gently rising plateau and up this for an indefinite distance, varying from 100 to 300 or 400 yards. The ground beyond is generally bare, such areas often being extensive, as in Pl. XXIII, and amounting to more than half the total dune surface; (3) the high landward crest also carries plants, whilst the lee slope shows patches of vegetation (Pl. XXIV, below). Occasionally, where owing to some topographic peculiarity, the lee slope has not been overlaid for some years by drifting sand, a fairly dense vegetation may establish. Such exceptional slopes alone are grazed.

Grasses occur on the seaward slope where there is much *Triticum junceum*. A few streamers of this radiate beyond the crest, but to no great distance. *Psamma arenaria* is also present here, but in very sparing quantity—a remark which applies to its occurrence on the landward crest and lee slope (Pl. XXV., below). In general, Marram Grass thrives indifferently in Portugal, and contrasts markedly with its normal growth in higher latitudes. The conditions are probably too dry and hot for this grass to flourish. On the non-mobile parts of the lee slope, *Dactylis*, *Arrhenatherum bulbosum*, and *Corynephorus canescens* may occur. On the whole a turfy carpet of grasses is rarely found on our dune.

The outstanding feature of the vegetation is a growth of low woody shrubs, about 2 feet high and separated by bare sand. Wherever this bush formation extends the ground is fairly well sheltered and not much sand is blown away. The plants contributing belong to a dozen or more species, and for the

most part come into flower at a later date than that of my visits (April).

The most conspicuous shrub is *Corema album* (Empetraceæ) reaching 3 feet in height and of spherical habit. By its form and dark evergreen foliage it can be recognised from afar (scattered plants with rings of bare sand round them in Pl. XXII., on the right). Its large rolled leaves are just like those of our *Empetrum nigrum*, on a magnified scale, and show the same adaptation. The roots of this plant are peculiar; they consist of numerous strands spirally twisted together like a rope. The collective structure descends vertically into the ground for 3 or 4 feet. Whether the unit-strands are actually secondary roots, or sectors into which an original primary root has separated, is uncertain. The plant bears white berries.

Lithospermum fruticosum, an erect, twiggy bush, which in April is a mass of brilliant blue flowers visible from afar.

Lavandula pedunculata, which is conspicuous everywhere in waste places in Portugal (Clarnecas), flowers freely in April. The flower heads are on long stalks and are crowned by prominent purple bracts. The plant is sold in bunches in the streets of Lisbon at Easter, and would serve very well as the Portuguese national emblem.

Diotis maritima and *Helichrysum Stæchas* are a pair of low composite shrubs everywhere common, the former being especially abundant on the seaward ridge. Both these have their leaves swaddled in white cottony hairs, the first named in particular.

Resembling these in habit, with imbricating leaves in opposite pairs, is the curious *Crucianella maritima*, not easy to recognise as the close ally of *C. stylosa* of the garden.

Then there are several species of *Armeria*—mostly much bigger plants than our own thrift. In this genus the Portuguese Flora is particularly rich, more than 20 species being represented. On the Comporta dune *A. pungens* and *pinifolia* are frequent as little bushes in these thickets.

Of other shrubby plants mention may be made of *Thymus carnosus* and *Anthemis maritima*.

Associated with this open scrub is a beautiful and interesting flora of herbaceous plants and bulbs, at the height of their

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COMPORTA DUNE, FROM THE EAST

The Comporta dune seen above the irrigated rice fields, half a mile distant. In the foreground women are hoeing ground before the grain is broadcasted on the water. Two miles south of Comporta. (April, 1926.)



LEE SLOPE OF COMPORTA DUNE

Landward (lee) slope of the Comporta dune abutting on the *Juncus maritimus* zone of the salt marsh. The conspicuous plants on the dune slope are cushions of *Ononis ramosissima*. Two miles north of Comporta. (April, 1927.)

flowering in April and May. The whiteness of the naked sand shows off their brilliant colours to perfection.

Dotted about everywhere is the charming *Senecio gallicus*, its yellow flowers rendered distinctive by a touch of orange. It is one of the few annuals of the Comporta dune.

Among the yellow-flowered plants must also be numbered *Lotus arenarius v. canescens*; *Medicago marina*, with its pale, silk clad leaves prone on the ground and sessile heads of lemon yellow flowers between; several species of *Linaria*, including *L. lusitanica*, *spartea*, *saxatilis*, and *Ficalhiana*—all these a great feature.

Among the crimsons and pinks are several low growing *Silenes*, *Malcolmia littorea v. Broussonetii* and *M. patula v. gracillima*, and the delicious rose-coloured *Ornithopus roseus*; on the lee slope restharrow (*Ononis ramosissima*) abounds in substantial patches, with luxuriant dark green foliage (Pl. XXIV., below).

Spread in mats prone on the ground is *Paronychia argentea*, the bracts of its flowers glistening like frosted silver against a white background of sand; occasional specimens of the Reseda-like *Astrocarpus sesamoides* are also to be found, whilst deep hues of purple are supplied by *Anchusa undulata*, especially on the seaward ridge where the sand is rich in lime.

Our own familiar *Carex arenarius* is an absentee, but its place is taken by the robust *Schoenus capitatus* of identical habit.

A feature is provided by the numerous bulbs scattered about among the other plants. The large squill, *Urginea maritima* and the sand narcissus, *Pancratium maritimum* both occur on the seaward slope, but do not flower till later in the season. Small blue scillas, and a small white-flowered snowflake, *Leucojum trichophyllum*, are not uncommon, whilst here and there the yellow *Iris lusitanica* may be found.

Along both margins of the dune are quantities of *Crepis bulbosa*, now in flower. This plant has thread-like underground runners radiating in all directions and each ending in a spindle shaped, translucent, water-holding tuber, from which next year's growth will start.

The above is but a selection from the bright constellation of plants belonging to the Comporta dune. Of them Professor Chodat has justly remarked, "Not a weed is visible here; each

plant is separate as in a cared for garden, in which one might fancy the beds had been hoed by an invisible gardener."* To a stranger the variety of species in small compass is bewildering (in a landscape such as is given in Pl. XXII. all these plants, and more besides, are to be found), whilst the rich colouring everywhere displayed by the flowers is something incredible to an Englishman. Though any true comparison with Alpine flowers is out of the question without placing the plants side by side under the same conditions, the impression I got is that these dune plants more than hold their own with the alpine colours. Some day perhaps the matter will be investigated from the point of view of ultra-violet rays. So far as sunlight is concerned I can only state my experience of two Aprils spent in Portugal. On both occasions I had not more than one dull day, and a few squalls on other days. It was a land of perpetual and penetrating sunshine.

For its atmospheric effects the Comporta dune is noteworthy. Its white sand takes the colours from the sky—often an after-glow at sundown—whilst the fact of its alignment due N. and S. produces a maximum contrast of morning and evening effects. The distant landscapes, which have at least as much value in dune scenery as in other types, include the high ridge and summits of the Serra d'Arrabida to the N. seen over the estuary leading to Setubal ; to the E. the salt marshes, irrigated ground and unending spread of *Charneca* on the settled dunes ; to the S. the blue mountains of Grandola and the dune ridge curving out to Cape Sines twenty miles away ; whilst to the W. is the Atlantic with its rollers beating on the foot of the ridge.

THE OLDER DUNES

It is not the purpose of the present article to deal with the older systems of sand dunes of the Comporta area, of which there are many scores of square miles. It must suffice to say that their soils are derived from the same initial type of coarse quartz sand that forms the active dune we have been describing ; but in process of time a rich humus has developed so that some of these soils are coal black, others chocolate, and others of lighter shade. Left to themselves these dunes become

* R. Chodat, *Excursions Botaniques en Espagne et au Portugal*, Geneva, 1909, p. 40.

covered with a dense scrub, waist high, in which *Ulex*, *Genista*, *Rosemary*, *Cistus*, and *Juniper* become important, as well as *Corema* and others of the plants already mentioned. *Pinus pinca* and *P. pinaster* flourish when planted, and become naturalised, whilst experiments are in progress with different species of *Eucalyptus* to discover those best suited to the conditions.

To-day, after many years, parts of these old dunes are being burnt over, grubbed, ploughed and sown with wheat, rye, beans, and other field crops, and every year the zone of cultivation expands. The truth is the Comporta district, apart from the irrigated ground where rice is grown, and certain favoured spots, has never been seriously exploited. This agricultural backwardness means that many scores of square miles of old sand dunes remain in the "Matto" or Charneca phase, producing nothing of any value except pine trees and wood for kindling. The direction of the land is now in good hands, and production is increasing. But in any event it must be a long time before these fragrant prairies of waste land (Charneca) are fully reclaimed for tillage.

As things now are this country is full of interest to the Ecologist. The Matto is not homogeneous, but the mixture of shrubs varies from one place to another. Ground carrying *Genista*, *Ulex*, *Cistus*, and *Juniper* is said to make good arable, whilst *Corema* is a sign of poor land. These notions are being put to the test, and experience gained of what fertilisers are needed to correct the deficiencies of the natural soils. Comporta would be an ideal place for an Ecological Station—something less ambitious than our Rothamsted Laboratory.

CURIOUS STRUCTURES

In concluding this account, reference may be made to certain curious objects which occur on the main Comporta dune, viz., tubes of cemented sand in little heaps along a line on the bare plateau midway between the shore and marsh. These tubes vary in diameter from 2 or 3 to 60 or 70 mm., and consist of coarse grains of quartz cemented together by a matrix of carbonate of lime. These tubes have been variously attributed to insects, worms, and lightning.

The first point to be noticed is that where the tubes occur

sand is being blown away, so that they are ancient structures coming to light. Moreover by following the line or horizon of occurrence, in addition to those lying prone, tubes are found at places *in situ* standing out from the surface as in our photograph on Pl. XXV., above. Where this is the case the smaller upstanding tubes may be traced down into larger, horizontally disposed tubes, and below these, on excavating, a plexus of much finer tubules is discoverable—the whole suggesting that these structures have been formed as incrustations around the bodies of dune plants of a former day. Often the cavity contains a core of humus, and the state of preservation in some cases suggests that, on examination, definite evidence would be obtained as to its source. Examination on the spot of the underground organs of living dune plants of comparable size revealed no trace of such sheaths, so the presumption is that if these incrustations are of vegetable origin, they are a *post mortem* development, the cement being a derivative of the shell debris present in the sand. Through the courtesy of Professor Adamson of the University of S. Africa (Cape Town) I have had an opportunity of comparing the Comporta structures with tubes derived from the dunes of the Cape Flats. The agreement is extremely close, and no doubt the conditions under which they were produced are substantially the same.

In Gerhardt's "Deutsches Dünenbau" reference is made to the frequency with which fulgurites are found where the sand is blown away on dunes of the German coast and elsewhere. These fulgurites (Blitzenröhren) are supposed to have originated from trees struck by lightning; the lightning as it found its way by the branching roots to the water table fusing the sand into a vitreous sheath, in the outer parts of which unfused grains of quartz remained embedded. In our case the sheaths show no trace of vitrification, the cement being entirely calcareous, so that their origin must have been different. Besides, on the lightning hypothesis, we should have to suppose that all along the line of the horizon in process of exposure—it extends for miles—every tree of some past epoch had been struck by lightning! As both the structure of the tubes, as well as their distribution on the ground, are opposed to the fulgurite theory, it seems probable that, when the specimens from Comporta and S. Africa are



SAND TUBES ON COMPORTA DUNE

Cementated sand sheaths of ancient dune plants (*in situ*) being exposed as the sand is blown away. In front are several tubes, belonging to a slightly higher level, which have toppled over. (April, 1927.)



LANDWARD RIDGE WITH MARRAM GRASS

Edge of plateau of Comporta dune above lee slope showing sparse distribution of Marram Grass. (April, 1927.)

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HISTORY.

fully examined and compared with other analogous structures, some other explanation will be forthcoming.

A Portuguese dune like that at Comporta differs markedly from its opposite number at home. It is much drier, and the plants (for the most part other than those we know) exhibit more conspicuously the structural qualities (termed xerophily) which include hairiness, leatheriness, rolled leaves, and water storing tissues. Grasses are unimportant in the vegetation and such a typical dune landscape as wind swept hillocks and stretches of marram grass overrun by ragwort does not exist. The vegetated regions carry a scrub of low bushes heterogeneously assembled, and on the bare sand between occur chiefly perennial herbs with flowers of brilliant hue. As usual the flowering period coincides with the forepart of the season, April and May being the months of maximum display. Variety in detail, even on quite small areas, is the rule, but the general effect of the whole borders on the desert type from which it is saved by the genial rains of winter and the moisture which the Atlantic brings.

III

METEOROLOGICAL NOTES, 1926

(From observations taken at Norwich)

BY ARTHUR W. PRESTON, F.R.MET.SOC.

JANUARY

THE mild weather which set in at Christmas, 1925, continued until January 12th, when it gave place to nine days of a severity unparalleled except in our coldest winters. On the night of the 15th the thermometer fell to 14.5 deg. in the screen and to 10.2 deg. on the ground, and on the following night to 12.2 deg. and 11 deg. respectively. These were the lowest temperatures recorded here since the 9th February, 1919. Some of the day maxima during this period were remarkably low, the thermometer not rising above 28.8 deg. on the 11th and 27 deg. on the 15th. There were considerable snows during this cold

period, but at no time did they equal those of the previous November, the greatest depth on the level here not exceeding four inches. On the 23rd there was a sudden change back to mildness, the temperature at 9 a.m. on that day having been 16 deg. warmer than at the same hour on the previous day. This mild weather continued until the end of the month.

FEBRUARY

The mild weather continued throughout February, the mean temperature of which month (44.3 deg.) was the highest recorded since 1869. There was only one night with frost in the screen, and on 16 days the day temperature exceeded 50 deg. Snow fell on one day only, and then to a very trifling extent. Rainfall was slightly above normal, and there was much cloud during the first half of the month, reducing the month's sunshine to 44 hours. The continued mildness brought on a very early start of vegetation.

MARCH

This month was notable for its abnormal dryness, the total rainfall having been but .37 in., constituting the driest March since 1874. Strong winds and gales prevailed between the 3rd and 12th, and the weather was very mild to the 16th, after which a winterly spell occurred, with snow on the 21st, as often happens at this period. The mean temperature of the month (44 deg.) was 2.5 deg. above the average, but slightly lower than that of February.

APRIL

Summerlike weather prevailed during the first six days, with temperatures more in accordance with July than April. On Easter Day (4th) the screened thermometer rose to 74.5 deg., being the highest temperature recorded here so early in the season since 1892. The month's mean temperature (50.3 deg.) was the highest in any April since 1874. There were some rather cold days in the latter part of the month, accompanied by much cloud, and the month's sunshine was 52 hours below the average. There was hardly any ground frost.

Rainfall was over an inch in excess. Thunder occurred on the 8th and 19th, on the latter day accompanied by large hailstones.

MAY

The weather was cold and unseasonable down to the 20th with hardly a day which could be called moderately warm. During the last ten days of the month, particularly during the Whitsun holiday, warmer weather prevailed, but on no day did the thermometer exceed 73 deg. Rain fell daily from the 4th to the 15th, (on which latter day there was a little snow) and some frosts occurred in the second week, doing much injury to the apple crop. Rainfall was half-an-inch below normal, notwithstanding that rain fell on twenty days. Sunshine was slightly in excess of the average, and there was a considerable preponderance of north-east winds.

JUNE

The outstanding feature of this month was the tropical thunderstorm which passed over Norwich on the afternoon of the 17th. This storm worked up from the north against a southerly undercurrent, and burst in its full fury over the city between one and half-past continuing until well after 3 p.m. The lightning was of unusual intensity, and the hail fell in such torrents that it was in places swept up after the storm in heaps nearly two feet high. The rainfall recorded here during the storm was .72 in., and it is stated that about half-an-inch fell in five minutes. During the earlier days of the month much dull, cool, and showery weather prevailed, and there was but little heat, the thermometer reaching or exceeding 70 deg. on four days only. Rainfall was .78 in. in excess of the average, and sunshine was 43 hours deficient.

JULY

The weather of this month was unsettled at times, but there were some very fine periods, that between the 11th and 14th being accompanied by great heat, the thermometer rising to 80 deg. and above on four successive days. Rain fell on eleven days only, and the month's total was nearly an inch below

normal, and sunshine was 20 hours deficient. There was a sharp thunderstorm on the evening of the 9th, and another, more severe, about midnight on the 18th-19th, with very sharp lightning, but not much rain. This storm was, however, very widespread, and in some places in the West and North-West of England the most severe for many years.

AUGUST

The weather of August was, on the whole, fine, pleasant, and summerlike, and favoured both the harvest and the holiday maker. Although the rainfall was a trifle above the average, two-thirds of the total fell in heavy thunderstorms on the 10th and 11th. The thermometer exceeded 70 deg. on 17 days (which are more days than in any August since 1918), but did not quite touch 80 deg. Sunshine was 20 hours in excess of the normal, and with the exception of 1923 was the largest amount registered in any August since 1911.

SEPTEMBER

The weather was warm for the season down to the 20th day. On the 19th the thermometer rose to the exceptional height of 86 deg., this being the highest reading so late in the season since these observations were commenced in 1883. The last ten days of the month were unseasonably cold. The contrast between Sunday the 19th, and the following Sunday was remarkable, the latter day having been as much as 33 deg. colder than the former. Notwithstanding this cold spell the month's mean temperature was 2.3 deg. above the average, and it was the warmest September since 1898. Rainfall was only about half the average, the severe thunderstorm on September 1st which caused so much rain in London and neighbourhood not extending to these parts. Sunshine was about five hours deficient, this being due to some very dull days at the beginning of the month.

OCTOBER

The month opened with a week of magnificent weather, with constant sunshine, reminding one much of the same period in 1921, but less warm than in that exceptional year. On

the 6th the temperature touched 70 deg., and the mean temperature of the first eight days was nearly 8 deg. above normal. Following a gale on the 9th an unsettled and cold period set in, and from the 15th to the end of the month the weather was quite winterly. While we were spared the snowstorms and intense frosts which occurred in many parts of the Kingdom the cold here was, nevertheless, of an intensity but rarely felt in October. There were no fewer than 14 days when the thermometer failed to rise to 50 deg., and frost occurred on the grass on 13 nights, the lowest reading having been 22 deg. on the 26th. Rainfall was rather under normal, and sunshine 21 hours in excess.

NOVEMBER

This was a dull month with much rain at times, and considerable fogs towards the end of the month. Mean temperature was rather above the average, and the thermometer exceeded 50 deg. on 13 days. There was a remarkable absence of frost, the sharpest night having been on the 1st, when the thermometer fell to 28.9 deg. in the screen and to 23.8 on the grass. After the 1st there was not another frost in the screen until the 26th. The total rainfall was about half an inch in excess of the normal, but fell very far short of the large amounts of rain registered in many parts of the South-West of England. Total sunshine was only 42 hours, of two-thirds of the normal. There were eight days absolutely sunless and 11 other days on which the sun shone for less than an hour. Very low barometer readings occurred on the 19th, 20th, and 21st, the mercury remaining below 29 ins. for 65 hours, and descending to 28.59 ins. on the 20th.

DECEMBER

This month was finer and drier than November, with 57 hours of sunshine and only half its normal rainfall. There was but little frost, and although the thermometer fell below the freezing point on the grass on 23 nights, the frosts were but slight. Snow fell on the 20th, and further storms of sleet and hail occurred on the two following days. Mean temperature was 0.5 deg. above normal. The barometer rose to 30.58 ins. on the 10th and to 30.72 ins. on the 23rd.

THE SEASONS

Tables of Mean Temperature and Rainfall of the four seasons of 1926 (including December, 1925, but excluding December, 1926), and compared with those of the five previous years and with the average.

TEMPERATURE

Seasons	1921	1922	1923	1924	1925	1926	Average for 30 years.	Departure of 1926 from average
	degrees	degrees	degrees	degrees	degrees	degrees	degrees	degrees
Winter -	41.7	40.2	41.3	37.3	41.6	39.7	38.4	+ 1.3
Spring -	49.6	46.9	47.3	46.7	47.6	48.5	46.7	+ 1.8
Summer -	62.1	57.9	60.3	60.2	61.5	60.6	60.2	+ 0.4
Autumn -	51.3	48.4	47.8	51.2	48.2	50.3	50.1	-0.8
Year - Jan. to Dec.	51.5	48.3	48.7	49.4	49.2	50.0	48.8	+ 1.2

RAINFALL

Seasons	1921	1922	1923	1924	1925	1926	Average for 35 years.	Departure of 1926 from average
	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.
Winter -	5.58	9.86	8.07	7.40	6.06	7.26	6.21	+ 1.05
Spring -	4.17	5.32	3.95	6.58	6.31	4.70	5.55	-0.85
Summer -	2.57	10.54	6.45	6.08	4.65	6.92	6.89	+ 0.03
Autumn -	4.65	6.06	8.84	10.86	8.51	7.01	7.83	-0.82
Year - Jan. to Dec.	15.71	32.49	27.74	30.77	25.10	24.66	26.48	-1.82

The winter, notwithstanding exceptionally severe spells, was, owing to the mild February, 1.3 deg. above the average temperature, the spring was nearly 2 deg. above and the summer slightly above. The autumn was colder than usual, although less so than in the previous year. The winter's rainfall was about an inch beyond normal, that of the spring showed a deficiency of nearly the same amount. That of the summer was in close agreement with the average, while the autumn was somewhat deficient in moisture.

THE YEAR

The mean temperature of the year (50 deg.) was higher than that of any year since 1921. The hottest day was September 19th (86 deg.), and the coldest night was January 16th-17th (12.2 deg.). January, February, March, April, July, August, September, November, and December all gave mean temperatures higher than the average. The other three months were colder than usual, the most markedly cold month being October. It was notable that both the earliest and latest high readings of the thermometer for many years occurred in 1926, the high reading of 74.5 deg. on April 4th having been (as previously mentioned), the highest so early in the year since 1892, and the high reading of 86 deg. on September 19th having been the latest reading of so high a temperature since these observations were commenced in 1883. The year's rainfall was 1.82 ins. deficient. The wettest month was November with 3.09 ins. of rain, and the driest was March with only 0.37 ins. The sunniest month was May with 213 hours of bright sunshine, and the dullest months were February and November with 45 and 42 hours respectively. The total year's sunshine (1469 hours) was 114 hours below the average, and such total was the lowest of any year since 1916, when there were only 1260 hours. Mr. Willis has again most kindly supplied the readings from his Campbell-Stokes sunshine recorder. A remarkable feature of the year was the magnificent weather which prevailed upon each of the four Bank Holidays. There were some severe thunderstorms during the summer, the most notable here having been that of Thursday afternoon, June 17th, above alluded to, but that of the night of July 18th was in many parts of England far more severe. The writer happened to be visiting the English Lake District at the time, where the full force of this storm was experienced, and it was, without exception, the most terrific and alarming electrical display within his recollection. The instruments at this Station were inspected and examined on September 28th by Mr. Read, one of the Inspectors of the Meteorological Office, who reported all as satisfactory. He was much impressed with the maximum and minimum and dry and wet-bulb thermometers, all of which had been in daily use for over forty years, and in no case had changed by more than one-tenth of a degree; two of them had not changed at all and were absolutely correct.

MR. PRESTON'S METEOROLOGICAL RECORDS FOR 1926

MONTH 1926	BAROMETER				THERMOMETER				HYGRO- METER Mean Relative Humidity 9 a.m. %	SUN- SHINE Hours	RAINFALL		WIND								Mean esti- mate force	
	Highest	Date	Lowest	Date	Highest	Date	Lowest	Date			Inches	No. of Days	N	N.E.	S.E.	S	S.W.	W	N.W.			
JAN.	30.41	12	29.33	3	52.7	25	12.2	17	90	56.4	2.78	21	0	1	2	6	13	2	5	2	2.9	
FEB.	30.52	28	29.25	2	56.5	26	29.4	14	87	44.5	1.95	16	3	3	2	3	3	7	6	1	3.1	
MARCH	30.48	1	29.41	27, 28	59.0	8	28.5	25	77	119.7	0.37	9	5	3	5	1	1	4	9	3	3.9	
APRIL	30.22	5	29.21	20	74.5	4	33.3	13	78	107.5	2.81	18	2	6	3	5	2	6	3	3	2.4	
MAY	30.11	25	29.45	30	73.0	26	33.7	9	74	212.6	1.52	20	4	8	1	4	2	5	3	4	3.9	
JUNE	30.38	29	29.41	10	77.0	20	42.0	26	78	163.0	2.71	19	7	4	2	3	1	3	5	5	3.1	
JULY	30.33	31	29.54	25	83.0	12	45.1	27	75	190.2	1.67	11	6	5	5	2	2	4	3	4	3.0	
AUG.	30.37	28	29.67	11	78.7	31	43.5	5	75	205.1	2.54	12	9	2	1	2	3	5	6	3	3.2	
SEPT.	30.40	30	29.66	12	86.0	19	38.0	26, 27	84	144.0	1.14	12	0	3	1	2	2	7	5	10	3.0	
OCT.	30.46	4	29.23	25	70.2	6	26.7	27	81	126.2	2.78	20	5	2	6	1	1	4	6	6	3.0	
NOV.	30.21	25	28.59	20	55.0	11	28.9	1	91	42.1	3.09	21	0	1	2	7	9	5	5	1	2.8	
DEC.	30.72	23	29.60	3	50.0	28	28.4	27	89	57.3	1.30	15	3	4	2	1	0	4	7	10	2.9	
MEANS									82													3.1
EXTREMES & TOTALS.	30.72	Dec. 23	28.59	Nov. 20	86.0	Sept. 19	12.2	Jan. 17		1468.6	24.66	194	44	42	32	37	39	56	63	52		

IV

BIRD NOTES, 1924-26

BY A. H. PATTERSON

THE following notes are offered in continuation of those published in the Transactions for 1922-23.

1924

BLACK-THROATED DIVER

A rather unusual number of Black-throated Divers appeared on the East Norfolk coast during the winter of 1923-24. An adult in full winter dress was brought to me sadly smeared with petrol waste, and I received also a younger bird, in better condition, which was picked up on the beach. Two others were received by Mr. E. C. Saunders, from one of which he took three six-inch Bream and four Smelts. One of these Smelts was four inches long.

BIRDS AND CRUSTACEA

Crustacea provide a favourite and easily obtained food for many wading birds; but Starlings and Sparrows have also acquired a liking for shrimps and repair to the boats of the shrimpers, particularly in the nesting period, picking the shrimps out of the emptied baskets and from the nets hung up to dry. I have even seen domestic fowls board the shrimpers for the same purpose. Rooks prowl along the mud-flats filling their gular pouches with stranded crustacea and taking them to their nestlings in the churchyard trees.

GREBES FEATHER-EATING

When hidden, early in June, in a bird-photographer's hide on the edge of the Decoy Broad at Horning, I had for some time several Grebes—evidently males—under observation. A male bird was very busily attending to his striped young one. I saw him deliberately bend his head, snatch a feather from his neck, and swallow it. Keeping watch on him, I saw him pluck a second from near his tail and swallow that also. Mr. King, to whom I mentioned the fact, could scarcely believe it, but himself looked for this curious trick, and afterwards assured

me that he had seen a male Grebe, quite close to him, flick off a back feather and offer it to his baby bird, which at first refused it. When, however, the feather was dipped in the broad the little fellow seized and swallowed it. When discussing feather-eating with a broad-man I was assured by him that a bird stuffer, when skinning some Great Crested Grebes, found quite a ball of feathers in the stomach of each.

FOOD OF THE LITTLE OWL

There can be no doubt that the Little Owl has come to stay, and also that it commits crimes that are inexcusable to the game-keeper. That it makes some amends is also equally certain. Master Ted Ellis, a boy naturalist friend of mine, exploring a wood, found a nesting place of a Little Owl in a hollow tree, from which he extracted a pint or more of hard remnants of Cockchafer beetles, with a few remains of other beetles. I myself found the "husks" of Rose Chafers, violet beetles and some others. At Catfield Fen in June I found hundreds of Little Owl pellets of which I took away a handkerchief full. On disintegrating these at home I found them to consist of the skulls and fur of the Little Shrew, among which were a few skulls which appeared to be those of bats—not a feather among them!

1925

WILD GEESE

Geese were exceptionally numerous in the winter of 1924-25, and their flights from the marshes to the sea and back were a daily feature. They were most numerous on February 19th, when several flocks of over 1,000 were seen. During a gale earlier in the month a lot of tired geese alighted in a Yarmouth North-end allotment. The gardener cautiously crept in line with a shed hoping for a chance to spear one or more with a pitch-fork, but the wind, suddenly rattling a loose sheet of corrugated iron, put the birds to sudden flight.

FOOD OF THE BITTERN

A well-known river man, when rowing me across his little broad, assured me that a pair of Bitterns nested in a quiet

corner, and that, on suddenly disturbing one of them, it promptly vomited five young birds which he believed to be Reed Warblers. A wounded Bittern sent to me from Aldeborough for treatment, was exceedingly vicious as well as shy. It took its food slyly, when my back was turned. Later it became somewhat accustomed to my presence and to my handling of its mending leg; but I had to cover its head with a sack to save my hands and eyes. Whitings up to four inches in length were readily taken and the wind-pipes of sheep cut into strips, as well as sliced plaice. Rats he sampled—chopped up—but afterwards objected to them. I gave him his liberty on Somerton Broad on March 17th, 1926. He had a last shot at my face as I turned him out of a tub, but missed me by inches.

GULL-BILLED TERNS

(Note dated May 16th) "Saw four Gull-billed Terns flying up and down Breydon channel. They had black feet and bills, and looked rather dark on the feather ends of the wings. Flight seemed more like that of the Black-headed Gull than of the Common Tern. Got so excellent and close a view that I could not be mistaken. They seemed to be after insects on the surface of the water; no 'herring syle' was visible. They were there some hours." Of the ten examples of this Tern killed in Norfolk nine were obtained on Breydon.

WOUNDED KNOT

The Knot is one of the most delightful of Breydon visitors—lazy, unsuspecting, and fond of the company of any waders that will tolerate it. One with a broken wing was brought to me on September 20th. I set its wing, and next day it ate as if nothing had happened. The third day it was content with earth-worms; on the fourth it accepted sliced beef, mixed with small worms and dropped into its water dish. On the fifth day it eagerly took common sand shrimps—tails first. Later, it fed on beef snips mixed with boiled potato, and daintily sampled egg pudding; but preferred worms to all else.

HAWK AFTER DUNLIN

On October 10th a Kestrel, hovering over a flock of some hundred Dunlin, singled out one of them which dashed towards

a drain and, flying low, much bothered the hawk, which hesitated to seize it above the water. The Dunlin shrieked, as one forcefully blows into a box-key ; on which a flock of about thirty Curlews flew to the rescue and chased the hawk away for a considerable distance.

ROCK DOVE

On December 9th a dove was picked up dead at Ludham which had been wounded in the breast. It was sent to me with a letter in which it was suggested that it might prove to be a Rock dove (*Columba livia*), an opinion with which I agreed. The bird was sent to Dr. Riviere, and was also examined by Mr. Witherby and Captain Lea Rayner. The latter, who is an expert on homing pigeons, considered it unlikely that it could be the produce of any domestic pigeon. The severe weather prevailing, with northerly snow storms, was probably responsible for its presence in Norfolk. The Yorkshire cliffs are undoubtedly its nearest breeding place.

1926

KESTREL AND NATTERJACK TOAD

On July 12th I gave my Kestrels a Natterjack toad to look at. The birds watched it with much interest from a branch, and one flew down, seized it with one foot, and bent over to bite it. The toad thereupon exuded a quantity of moisture, to the evident surprise and dismay of the bird, which hopped back to its roost with a very human effort at expectoration—as of one ridding the tongue of a hair.

It may be interesting to add that my tame Natterjacks objected to Cinnabar caterpillars and spat them out after trying one or two, wiping their wide mouths with their dainty fore feet.

HUGE JACKDAW'S NEST

Through the courtesy of Mr. Reginald Gurney of Spixworth I visited an enormous nest of sticks piled up by Jackdaws in order to reach a window of exit in a loft. It was shaped like a half-cone, the base being 21 feet round.

BIRDS AND WALNUTS

In my little garden at Hellesdon we had an aged hollow walnut tree. It was a famine year for the nuts and the few, that would scarcely fill a pint pot, were mostly appropriated by Starlings who attacked them when they were softish, and by Rooks when further ripened. It is odd how various creatures attack the same prey. The Squirrel nibbles the small end of a nut and then splits it with his incisor teeth; the Nuthatch fixes the nut in a crevice in the bark of a tree, hammers it tight, and then pecks a jagged hole to get at the meat. The Long-tailed field-mouse nibbles a small hole and by some means gets the inside out daintily. Equally interesting were some observations on the way in which Hares, Rabbits, and Rats individually attack beet in a field.

V

THE HERRING FISHERY OF 1926

BY A. H. PATTERSON

OWING to my retirement and removal from Yarmouth for a season I lost touch greatly with the progress of the herring fishery of 1926; while materials of an interesting nature were destroyed by an accident on my return. I am, however, able, through the courtesy of Mr. A. C. Canham, to piece together a fairly connected review of the season.

The 1926 Herring Voyage began with the heavy handicap of the great coal strike. The sailing boats—both English and Scotch—had vanished, entirely superseded by steam and motor craft; consequently the rise in price of coal to £3 10s. 0d. and later to £4 16s. 0d. per ton badly crippled the industry. Added to this, the weeks of stormy weather which obtained when the season is usually at its height did much damage to the nets. These discouragements so depressed the northern fishermen that, to quote Mr. Canham, “they cut their losses by leaving earlier.” This is not surprising when long spells of bad weather kept the boats in port and inferior coal from the continent made steam-raising difficult.

The Yarmouth Herring Fleet comprised 833 fishing boats in all, classified as follows:—

	Steam.	Motor.
Scotch	609	105
Yarmouth	110	
North Shields	6	
Other ports	3	

The Lowestoft fleet consisted of 470 vessels, as follows:—

	Steam.	Motor.
English	246	1
Visiting boats	188	35

The preceding statistics were sent to me by the Lowestoft Office of the Ministry of Agriculture and Fisheries. From the same source I am given to understand that 3,498 Scotch girls were employed at Yarmouth and 1,302 at Lowestoft. Also that the total of Herrings landed at Yarmouth was 393,870 crans, of an estimated value of £553,816.

WEEKLY LANDINGS OF HERRINGS AT YARMOUTH.

				Crans.	Crans.
				1925.	1926.
October	2	...	...	42,208	16,280
„	9	...	...	43,418	11,920
„	16	...	...	32,366	44,872
„	23	...	...	79,146	143,784
„	30	...	...	143,535	52,727
November	6	...	...	87,527	45,999
„	13	...	...	15,372	43,829
„	20	...	...	20,411	19,688
„	27	...	...	6,035	8,007
December	4	...	...	7,216	3,766
„	11	...	...	2,007	2,196
Season's Total				479,241	393,068
Decrease on the Season				86,173	Crans
Record Year Catch (1913)				824,213	Crans
Drifters Fishing ... ..				...	999 vessels
Barrels (Salted) Exported ... ..				...	820,527

The fishing opened fairly well and, as shewn, October saw the largest catches. The heaviest catches delivered in one day, October 21st, amounted to 34,793 crans, the produce of 519 boats. The smallest catch was delivered on December 1st when one boat landed 30 crans. The highest price obtained was £4 14s. 0d. per cran, which figures out at £47 per last (old style) of roughly 13,200 herrings. The date of this record price was December 6th.

The lowest figure recorded was 17s. per cran on October 21st. This would correspond to £8 10s. 0d. per last. According to Mr. de Caux ("The Herring and Herring Fishery") he had known "fresh herring and 'bloater-stuff,' occasionally bring wholesale prices of £40 to £56 per last." The heaviest shot was 250 crans—a quarter of a million fish; this was landed by a Yarmouth boat on October 21st and realised £245. This was not a profitable catch, as it happened, for half her fleet of nets was damaged or destroyed, a loss which cost over £250 to replace. On the same date another local drifter, the "Ascendant," landed 250 crans, and another 240 crans. A Lowestoft boat which came in with 218 crans, the result of one trip, lost 30 nets through the weight of the herrings "grounding" (sinking) her nets. The bulk of the herrings are stated to have been captured near Smith's Knowle. In round figures the value of the Yarmouth catch was £600,000, as compared with the 1925 catch of about £850,000.

Yarmouth for many years has depended largely on the export of its herrings, "Pickles" (brine-cured fish in barrels) having been in great demand in certain European countries, particularly Russia. The chaotic state of that unhappy country has now made it impossible to continue trading with her people, although Russia may be drawing supplies through neighbouring States. The season's pickling was 338,632 barrels, as compared with 422,190 the previous year. Shippings have been made to Danzig, Stettin, Reval, Libau, Riga, Hamburg, Ymuiden, and other northern ports. The first export steamer to load was the "Ralum" of Königsberg on October 21st. One vessel, the "Glenderry" carried 7,728 barrels on one trip in November to Stettin and Königsberg.

The "Fresher" export known as "Klondyking" took 21,500 crans off the market. Mr. John de G. Lacy, Fishery Officer, kindly gave me the number of barrels of "pickled" herrings, which are as follows:—Yarmouth and Gorleston 338,632; Lowestoft, 106,210—a total of 444,842 barrels. He also stated that "Klondyking"—packing of fresh herrings in ice—is still very largely confined to Lowestoft, in spite of the efforts of the Yarmouth authorities to foster it. About 140,000 crans were shipped from Lowestoft to Altona, mostly in boxes, and 25,500 from Yarmouth. It will be interesting to watch the progress of Klondyking during the next Fishing, at Yarmouth, for which process a notable extension has been made at the Fish wharf. Rivalry between the two herring towns in the past led to disputes that ended in blood-shed; to-day it is a matter of good-tempered rivalry.

GENERAL REMARKS

With the decrease of wooden vessels, those employed in certain trades, such as block-makers, rope-makers, and blacksmiths have diminished in numbers. Coopering, on the other hand, has vastly increased, and box-making has become a thriving industry.

An interesting feature is the import of fish-salt, 22,000 tons having been brought in by 22 steamers. Some of this was brought from Runcorn and Weston Point, but the bulk of it came from the Balearic Islands.

Cargoes of barrels and wood for local barrel factories made for busy scenes on the quays.

The introduction, and increasing use, of wireless at sea have increased the safety of the fishing vessels, by giving warning of approaching gales.

Loss of life was exceedingly small, one Scotch fisherman having been drowned in the harbour when attempting to board his vessel. A Buckie boat sprung a leak and was lost on November 5th; another from the same port was lost a few days later, the fishermen in each case being rescued. During a severe storm a Peterhead drifter was 36 hours towing a disabled Buckie boat a distance of 38 miles.

It may be worth while making reference to the declining popularity of the kipper, a very tasty table dainty when

properly smoked, which was invented some years ago by the head of the Woodger family. Many of the fish-curers have failed to keep up to the high standard of smoke-cure set by the Woodgers, and the trade has suffered in consequence. The latest blow to this excellent method of cure has been the introduction of colouring matter and a hasty method of smoking hardly worth the name. In some cases I have suspected, from experiment at the tea-table, an inferior class of fish, as regards condition and freshness; while a superfluity of salt has made a very unpalatable article. Much complaint was also made of unscrupulous bloater-curers who used—and I fear still use—coke fires instead of oak biliet-wood, in bloating the herrings.

It was for a long time the practice of unscrupulous costers to purchase the unfit "black" herrings from small fish-curers. These they made into small bundles around which a bit of old herring net was tied. Their methods of selling them to excursionists going along the quays to Vauxhall station were as unsatisfactory as their wares; but the opening of small fish shops on this route has done much to oust these undesirables.

VI

THE FUNCTIONS OF A LOCAL NATURAL HISTORY SOCIETY

BY ROBERT GURNEY, PROF. F. W. OLIVER,
DR. E. J. SALISBURY, AND T. C. BLOFELD

I. BY R. GURNEY

It is easy to say that the main functions of a provincial natural history society publishing Transactions, such as our own is, should be the investigation, recording and preservation of the fauna and flora of the County. Our Society has a record of work done of which it has every reason to be proud, and our Transactions contain a rich store of information on every aspect of the natural history of the County, much of it of great scientific value. On the other hand this work is the product of a very small minority of the members. There must, of

course, always be a large proportion of members who have neither the time, the training, nor the inclination to do any scientific work themselves, however much they may be interested in the work of others; but there probably are, or at least there ought to be, a considerable number who could undertake some work, especially if definite suggestions could be made to them of the lines on which they might do it. In making the following suggestions for work in fields with which I am not myself familiar I am guided, not so much by any positive knowledge that these are problems which require solution, as by the fact that they are questions on which I have sought information without success. It may often be profitable to retread old paths of research and to verify anew that which has already been observed; while that which has the freshness of discovery to one will surely prove a novelty also to many of those to whom the results are communicated.

These suggestions, which were discussed at one of our meetings, have been submitted to Prof. Oliver for criticism. The thanks of the Society are due to him and to Dr. Salisbury for their additional suggestions and comments.

As regards the eventual publication of results in our Transactions one difficulty arises. While on the one hand we must avoid what is trivial or of merely transient interest, it is not advisable that work of wide and serious interest should be published in a periodical of limited and local circulation. Nothing is more galling to a scientific worker than to find a reference to an important paper on his own subject in a periodical to which he cannot obtain access. In particular no descriptions of new species should ever be so published.

The suggestions I have to make myself are as follows:—

(1) Two species of the molluscan genus *Clausilia* are recorded for Norfolk, one of them simply as "common." I have found one of them quite common in West Norfolk; but I have never seen it in East Norfolk, and it would seem that the genus is not evenly distributed. It would be of interest to obtain a really thorough map of its distribution in the County together with detailed notes of the kind of situation in which the two species are found. The genus is easily recognised, though probably the species are not. Those who are not able to give time to make themselves acquainted with the

species should collect specimens from each locality in which the genus is observed and forward them, together with their notes, to someone who will act as referee and recorder. The Rev. F. W. Nevill (Old Catton Rectory) has kindly undertaken to name specimens submitted to him.

A mere record of the occurrence of *Clausilia rugosa* in the County of Norfolk, or indeed in a few localities in Norfolk, is of little or no scientific value; but, when our knowledge of the distribution of the genus approaches such completeness that we are able to say that a species does *not* occur in a certain area or in certain surroundings, we are getting very much nearer to a solution of the general problem of local distribution not only of the genus *Clausilia* but of other terrestrial animals too. Such a work might take years to complete, but it should be valuable if conscientiously done.

(2) The Woodlice of Norfolk have never yet been worked at, and it would be interesting to obtain an accurate knowledge, not only of the species which occur, but also of their distribution within the County. A good text-book of them has been published (Webb & Sillem. *The British Woodlice*. London, 1906) which makes their identification fairly easy.

(3) Anyone who has visited the Bure and the Yare valleys in summer will hardly fail to be struck by the dissimilarity of the flora. *Thalictrum flavum*, to mention one plant only, grows abundantly on the Yare marshes, but not at all on those of the Bure as far as I am aware. I do not know of any thorough treatment of this subject, certainly not at the hands of a Norfolk botanist. Miss Pallis has dealt with it to some extent (*Types of British Vegetation*, 1911), but it should be possible for members of our society to take it up and to establish first the extent of the difference, and then the nature of the causes. Here is a case in which team-work is specially called for. Dr. Salisbury points out (p. 312) the difficulty of organising such work, but its success when so organised is finely shown by the publications of the Blakeney Point Laboratory under the direction of Prof. Oliver. Another example of ecological botanical work which has been fruitful of results is that of Dr. E. P. Farrow (*Journ. of Ecology*, III. p. 211, 1915) on the Breckland flora and the influence thereon of rabbits.

It seems to me that it would be of interest if someone would

undertake to survey the grass- and marsh-lands of our river valleys with a view to ascertaining by local enquiry which of them at one time grew corn, and how far conditions have changed, as a result of drainage, etc., since those days. Such a record, simply as a record, could not fail to be of value, since such information is probably still obtainable, but will be lost with the passage of a few more years. Some of these marshes were broken up and planted with oats during the War—what has been the result?

(4) Grigor's "Eastern Arboretum" was published in 1841 and gives an account of all notable trees then standing in the County. It would be well worth while to seek out these trees, to record their fate if they are gone or their growth if they still live, and to add notes of any specially fine trees which were overlooked by Grigor or have grown into prominence since his time.

(5) In Bentham and Hooker's British Flora (1900) one species only of the Water Buttercup is admitted under the name of *R. aquatilis*: but the London Catalogue of 1908 recognizes 10 species, and the Cambridge Flora (1920) includes nine. These species are difficult to discriminate and, so far as I know, no effort has been made to test their "specificity" by experiment. There should, one would think, be a fruitful field for research in this direction. Do such species when grown experimentally under conditions in which they do not normally live retain their specific characters? The late Mr. A. Fryer did much to unravel the tangled nomenclature of the genus *Potamogeton* by growing the plants in his own ponds, and the same sort of work might be undertaken for the genus *Ranunculus*.

An accurate working out of the distribution of the species in the County would itself be valuable. For instance *R. drouettii* is said to be "locally common" in Norfolk—what exactly does this mean? What are the conditions which determine the presence of *R. heterophyllus* and the absence of *R. drouettii*?

(6) Our knowledge of the fresh-water mollusca of Norfolk is very defective. It would be valuable if the Broads could be systematically worked, so that it was possible to draw up *complete* lists for each broad and section of the rivers and to compare them, with special reference to their salinities, etc.

One would then have a basis for comparison with other river systems, and a thoughtful analysis of such data would be a valuable contribution to the Transactions. Another direction in which such data would be of use would be in ascertaining to what extent our rivers have retained a fauna derived from connection with the old Rhine system, and how far such differences in the molluscan fauna as can be shown to exist between our rivers and the rivers of the west, for example, can be explained as a result of past history. The question of the relation of the eastern rivers of England to the Rhine system has been raised again recently by Prof. J. W. Gregory (*Geog. Journ.* July 1927). A valuable contribution to the solution of this problem would be a statement of the evidence which at present exists and the direction in which new evidence may be sought.

(7) Here and there in books on Norfolk references may be found to coast erosion and the loss of churches and villages, but I have never seen any connected history of the coast worthy of the subject. There is much information available in the records of the Sea Breach Commission, from which it would be possible to write a fascinating story of the struggle against the sea. The conditions in the river valleys when the sea poured without hindrance through the breaches in the sand-hills are illuminated by such stories as that of a marshman who sailed his wherry from Potter Heigham to Martham over the marshes without touching anything but the tops of the litter stacks.

(8) Finally I would point out that there are many small problems which obtrude themselves on anyone of an enquiring disposition and to which an answer cannot easily, or perhaps at all, be found in literature. For instance what is the rate of growth of the Yellow Water-lily? Seedlings without trace of root-stock abound in autumn, and the smallest plants with rudimentary root-stock must be in their second year; how old then must be those plants with root-stocks five feet long! Again who knows the rate of growth and duration of life of the fresh-water Mussel? Why are the paper-thin young so rare? Can the age of a mussel be told by its lines of growth? There is much literature on American mussels, which are of economic importance, but I know of none about our English species.

I should imagine that a fascinating subject for enquiry would be the life-histories of insects, but do not know how far this field has already been explored. Still, it does not follow that, because a subject has been written about, it is thereby exhausted. I have myself recently found much pleasure in searching for the larvæ and pupæ of the beetle *Donacia* on the roots of various water plants. The life history has been fully described by Böving, but that has not lessened the interest of discovering it anew for myself.

I have deliberately omitted certain lines of work which occur to me, such as the plankton of the Broads and its relation to salinity and so on, since this is a subject only to be dealt with satisfactorily by one who is not only a skilled systematist but also something of a biochemist as well. It is not particularly difficult nowadays to ascertain the composition of plankton, but it is unlikely that such work of itself would be of much interest in our own area, and no general conclusions could be reached without a study of the biochemical factors. One does not wish to add to the appalling accumulation of undigested facts under which Limnology is being submerged.

2. BY DR. E. J. SALISBURY

THE ideal activity for a local Natural History Society would be a co-operative effort in which members who were specialists in various departments would, either in the capacity of directors or referees, assist the more generally equipped to investigate the ecological relations of some naturally defined area. Such an ideal is, however, usually incapable of realisation for various reasons. Firstly, because for most members of Natural History Societies the study of natural phenomena is a leisure time occupation, a relaxation from other and often onerous duties. As such it is natural and proper that inclination should be a guiding factor in its pursuit rather than the necessity of fitting into a preconceived scheme. Further, the time available is irregular both in its incidence and amount, whereas a properly conducted co-operative effort demands observation at a given time and place. When to these difficulties is added the fact that the leisure of different individuals rarely coincides either in place or time, it will be realised that any effort at close

co-operation is as difficult as the mathematical treatment of a number of variables.

The direction, however, in which the activities of Natural History Societies have been most fruitful in the past and for which they are pre-eminently fitted, is in the accumulation and record of the data upon which the generalisations of the student of geography in its widest sense are based, and in the observation of biological phenomena.

It is to the Natural History Societies that we owe the raw materials out of which our local floras have been built, and although our knowledge of the distribution of flowering plants is fairly complete for many parts of the country, a great deal still remains to be accomplished in this respect in regard to the cryptogams and many of the less familiar groups of animals.

Conclusions respecting the relation between habitat conditions and geographical area cannot satisfactorily be based on one group alone, but should take cognisance of the higher and lower members of both the animal and vegetable kingdoms. At the present time, however, we are forced by our partial knowledge to rely for our geographical generalisations on a comparatively limited range of groups, but Natural History Societies could do much to broaden that basis by accumulating data with respect to those animals and plants whose distribution is as yet incompletely assessed.

Respecting biological phenomena much has been done with regard to the time of flowering of various plants, but even more important is the accumulation of other phenological data such as the dates of leaf expansion and leaf fall ; the average period of germination of the seeds of wild plants in nature ; the rate of spread either by seeds or vegetative means ; the rooting depth of species on different types of soils. All these and similar data require no co-operative effort and only demand accurate observation and care. They are thus especially adapted for record by those whose time for observation is variable in amount and intermittent. Each observation is, moreover, complete in itself, and therefore entails no liability on the further leisure of the individual.

Provided every care is exercised in their collection, such data are of great value in the study of competition and in assessing the rôle of individual species in the communities of

which they form a part. How much remains to be done in this direction can be gauged by the fact that it is probably true to state that the life history and biology is not completely known in the case even of the commonest British plant.

3. BY PROF. F. W. OLIVER

I AM in general agreement with Dr. Salisbury's note on Natural History Societies, with one of which, as Secretary and then President, he has intimate knowledge. The membership must as a rule be too heterogeneous to co-operate closely in the field, in which respect they are less handy than parties of University Students who have a common outlook and discipline. Unless therefore, some Pied Piper of Hamelin should arise, the necessary wave of enthusiasm to move such a body will hardly be forthcoming. None the less, much useful work lies to their hand, of which a single example on the botanical side may suffice.

In the immediate future the British Ecological Society will be arranging for the preparation of an Ecological Flora of Great Britain, a work that may extend to the compass of two or even three volumes. This will concern itself more especially with the occurrence, habitats, habitat forms, times of flowering, and life histories in general of British plants. By allocating the Norfolk plants among the membership everyone taking part would have a clearly defined task, and in the course of a season or two much information on the required lines should be forthcoming, all of which would find its place in the contemplated book. Very shortly, a printed specification of the kind of details required will be issued for distribution, together with a tentative draft or model example of what is intended for a single species. With these in hand and a certain amount of local organisation, the work should proceed smoothly, and so far as Botany is concerned, go some way towards filling the lacuna to which the Treasurer of the Norfolk and Norwich Naturalists' Society has drawn attention.

4. BY T. C. BLOFELD

AS a result of a speech last year by Mr. Robert Gurney, it occurred to the writer that there was a large amount of at

present uncoordinated effort in the Society which might profitably be harnessed to deal with problems of scientific interest to commercial agriculturists and horticulturists. Research work on these subjects is nowadays at any rate, in its ultimate value, very largely dependent on the presentation of a mass of observations by a skilled worker well versed in statistical method. In order that such a worker may collect his data he must have working for him a fairly large number of observers, all in some degree scientists, all intelligent, and all capable of making and recording careful observations. Many of the members of this Society are observers such as I have described, and it is the purpose of this article to point out to them the fact that there is a deal of important work which they can do, and that there are plenty of trained men who would be grateful for such help and only too willing to co-ordinate their observations if they were collected in sufficient number.

From the purely horticultural point of view there are numerous problems with regard to fruit trees which are eminently suitable for the semi-skilled investigator; although, as with most biological problems, observations to be of any value must be made over a considerable period of time.

1. The colour of fruit, particularly of apples, and its variation with the composition of the soil and with other factors, is a subject of great interest. It is held that on certain soils the application of Potash will enhance the red colour of many dessert apples; but this statement has not properly been investigated on soils of a craggy nature such as are to be found in Norfolk. From the practical point of view such an investigation should be of value, since on these soils the variety Cox's Orange Pippin will grow and crop fairly well, but will not produce, under ordinary conditions, apples of a very high colour. Colour in this variety, as in many others, is largely the determining factor of the price obtained for the apple.
2. The effect of thinning an apple tree in mid-June might be investigated with reference to the loss or gain in weight of apple ultimately produced, and the size and colour of the fruit. Experiments on pruning have already been carried out in great variety, and there is a considerable

mass of literature on the subject. By judicious reading and some practical knowledge it is frequently apparent that methods have not been pushed to their logical conclusion, in their effect, for a length of time necessary to a proper judgment of them.

3. From the point of view of general interest, of systematic botany and of agriculture, the plant population in different places is a subject of profitable study. Valuable information about soils can be obtained by comparison of the normal plant population of an area with that of similar ground which has been farmed for a great number of years and with again similar land on which definite dressings of particular fertilisers have been applied. A considerable amount of work has been done both on soils and on weeds and ideas for future work can be got from what has already been published. The reader is referred for suggestions to Hall & Russell's report on the soils of Kent, Surrey, and Sussex, and to Miss Brenchley's book on Weeds.
4. For anyone with a leaning towards Mendelism and genetics there is a great field as yet undeveloped in the selection of pure strains from wild, garden, and farm plants. An example may be taken from the Martagon Lily which has a rare white variety never yet established in its genetical composition. Sugar Beet and Winter Barley would both be eminently practical lines on which the geneticist could work.

This has only given a few suggestions which members might care to adopt. If they do, or if they can suggest other problems of interest to agriculture and horticulture which they are willing to investigate, I shall be glad to hear from them. They may be quite sure that in any investigation of value they can rely upon the advice and help of those men who are most capable of giving it.

VII

NATURE RESERVES

(Being a Report on the Conference of Delegates of Corresponding Societies at the Meeting of the British Association at Leeds, September, 1927)

BY F. W. OLIVER, F.R.S.

AT the meeting of the British Association at Leeds the subject of Nature Reserves was brought before a session of the Delegates of Corresponding Societies. A general notice of this discussion had been given some months before, and Mr. Sheppard of Hull and I had been asked to speak on the subject. Unfortunately, the discussion which followed our opening strayed away from the subject of Nature Reserves in their general aspect, and it is doubtful if the discussion served any useful purpose.

MR. T. SHEPPARD, in opening the discussion, said it had not been found necessary in Yorkshire to arrange officially for reservations, as there were many landowners who maintained breeding grounds on their own initiative.* He instanced the cases of Spurn Point, Hornsea Mere, and Flamborough Head. Reference was made to the species breeding in each locality, and details were given of the methods followed by cliff climbers at Flamborough to obtain eggs, especially in the case of Guillemots' eggs, which are in considerable request. I understood Mr. Sheppard to say that he estimated the number of eggs thus robbed from the cliff at 130,000 per annum, in spite of which the colony of birds undergoes no appreciable shrinkage. The Guillemots' eggs are sold at 1d. each, except those of unusual marking, which fetch 10s. or even £1 from collectors.

F. W. OLIVER, in continuing the discussion, said that the subject of nature reserves was one to which delegates from all over the country could usefully devote some attention. His remarks would apply especially to matters of organisation and administration, of which he had had some experience in the last twenty years. In the present state of changing England, and especially of the revolution in communications which petrol

* Thus, the National Trust have no properties in the County except Sharow Cross, near Ripon.

and the motor car had wrought, he supposed there would be general agreement as to the importance and often urgency of obtaining representative examples of natural ground with its flora and fauna, so that these might serve as a present enjoyment and solace, and might be handed down to future generations intact, with records of their changing history.

Already many such areas exist. The National Trust have secured a considerable number, as also have the Society for Nature Reserves, the Selborne Society, civic bodies like the Corporation of the City of London, and so on. They work independently with a certain amount of correlation, but no organic connection.

RESERVES IN NORFOLK

As the representative on the present occasion of the Norfolk and Norwich Naturalists' Society, he thought the most useful contribution he could make would be to sketch in outline what had been done in the county in this matter, and then consider whether the experiences of Norfolk contributed anything likely to be useful in the solution of the general problems raised by nature reserves. As with Yorkshire, the county had landowners who paid regard to such amenities; nevertheless, in recent years there had been a decided movement in the direction of definite reservations. The beginning, so far as he knew, dated back to 1910, when the Lord Calthorpe of that day granted him a lease of Blakeney Point for purposes which were described as "marine horticulture." Two years later, on the death of Lord Calthorpe and the dispersal of the Norfolk estate, Blakeney Point was purchased privately and presented to the National Trust. The danger of its exploitation should it have fallen into unsuitable hands was thus avoided. Famous as the Point was as a place of call for birds on migration, and as it later became when the terns reorganised their breeding ground on land which in 1912 did not yet exist, it may be remarked that the effort which led to reservation came mainly from the botanical side. Enthusiastic birdmen viewing the breeding ground in its present flourishing state sometimes forget that the botanical interest of the area is second to none.

Next, following the War, an opportunity was found to assemble and reorganise a number of ill-supported birds

breeding grounds under one authority, the Norfolk Bird Protection Committee of the Norfolk and Norwich Naturalists' Society, of which Dr. S. H. Long, the moving spirit, became Secretary. The results of this work have been most satisfactory, as the increase of the birds cared for, and of annual subscribers, alike testify.

SCOLT HEAD. A few years ago the extensive, beautiful, and faunistically and botanically most attractive area known as Scolt Head was offered for sale privately on generous terms. With the assistance of the local press the appeal for funds met with an instantaneous and enthusiastic response, so that within a few weeks the purchase price, as well as a nest egg for upkeep, were obtained. By a private benefaction, a well equipped hut was provided so that naturalists could reside and carry on their observations under the best conditions. This property also was handed over to the National Trust (1923).

In the opinion of the speaker the case of Scolt Head proved abundantly the existence of a fine local patriotism, capable of responding generously, and marked a definite step in the nature protection movement in the County.

Last year the Cley Marshes, formerly in the possession of the late Mr. A. W. Cozens-Hardy and well known as a sanctuary for many breeding birds and in winter as a sporting estate, were bought at public auction by Dr. Long and a group of ornithologists. As there were good reasons why it was not convenient that this property should pass to the National Trust, with the approval and encouragement of that body Dr. Long founded a special, non-profit-paying company or association under the Board of Trade, to administer it under the name of the NORFOLK NATURALISTS TRUST, with powers to acquire or take over other areas. Membership, by annual subscription or payment of a lump sum, has secured a balance of the order of £1,000, so that this Trust is in a position to advance in other directions. Special attention was drawn to the Articles of Association and regulations of the Norfolk Trust which are drafted in a broad spirit, and are more flexible and perhaps more far-reaching than those of the National Trust itself. Certainly the future history of this Trust should be well worth watching, with a view to the application of similar schemes

in other localities. It seemed to the speaker that by this act Dr. Long had perhaps gone a long way towards the solution of the problem of organisation. It had provided a territorial basis, with the county as the obvious unit. With the aid of the local press, by lectures, meetings, excursions, and other propaganda, the county can be kept informed of the general progress, and its enthusiasm aroused when some fresh sacrifice is required, and this in a way quite impossible in London.

If the enterprise succeeded one would look forward to the time when every county would have its County Trust, which would hold and administer the areas it acquires.

Norfolk, no doubt, was favourable ground for such an experiment in view of the traditional and widely diffused devotion to natural history pursuits, combined with a strong local patriotism; moreover, the county is happy in being able to act as one unit, and not as two or three, as in districts where local jealousies or antagonisms exist. At the present moment perhaps the number of counties ready to take such action is limited, but here we seem to have the germ which may lead to far-reaching results. Should the idea catch on possibly an Act of Parliament might be promoted which would ease the way for such Trusts by creating a simple and inexpensive machinery.

As regards the National Trust itself, there seems no reason why it should not welcome the devolution which County Trusts would mean. Already in very many cases it gives to its local committees of management a very large measure of independence, and one might even look forward to a time when many of the properties now held by the National Trust could be handed over (or at any rate leased) to the County Trusts, so soon as they qualify by work done and financial stability. This delegation of functions would leave the National Trust more free to act as a correlating and advisory body, and to represent the movement in the Metropolis. Ultimately, the relation between the parent body and the County Trusts would have to be defined, and this might perhaps include the reservation of a right of veto for the National Trust. That was the speaker's notion, but it was a purely personal view. The great thing at the moment was to get the idea of County Trusts ventilated in the various districts represented by the delegates.

As regards finance, it was evident that those interested must expect to spend money—sacrifices would undoubtedly have to be made. It was not to be expected that grants from Town and County Councils, or from the National Exchequer, would immediately flow in, but later, should the movement make good, these might come. The more widely the financial burden can be spread the better, and the more likely to accrue are substantial subscriptions from rich and generous people. It would also be desirable that County Trusts should accumulate a useful balance, so as to be able to purchase swiftly when opportunities arise.

CLASSIFICATION OF AREAS.—A distinction has to be drawn between two separate requirements :

(1) The preservation of the amenities of growing cities—the advance of bricks and mortar ; Where would London be without Epping Forest, Richmond Park, Windsor Forest, and its numerous heaths and commons, such as Wimbledon ? These should be especially the province of civic bodies rather than the societies such as the conference represented, though we do well, no doubt, to keep touch and help in guiding such efforts.

(2) The preservation of the country and especially such parts as are threatened by new transport facilities, week-end bungalows, trippers, and the like. But we are not restricted to such places, for no one can foresee what will happen next.

A County Trust will consider areas representative of the county as a whole, and among these will be some of national importance, likely to attract visitors from all over the country and perhaps from abroad. Such " star " areas are not always easy to recognise off-hand—the difference between the *good* and the *very good*, though real enough, is rather subtle, and considerable experience and judgment will be called for.

There is much to be said for the occasional large area, and for this reason. Small areas in time advance by natural processes to another phase ; scrub becomes forest, fen becomes dry land, mobile dynamic areas become stabilised, sand dunes change their character, etc. This is inevitable and unavoidable, and the only remedy is to have areas large enough to provide new juvenile phases as others pass into older stages. Botanists, zoologists,

bird and insect men, are all equally affected by these changes ; habitat, vegetation, and fauna are all inter-related.

USES OF RESERVATIONS

They should be used as places of study, and, at the least, proper scientific, but not too technical, accounts of their features and resources should be made available.

Where possible, areas should be accessible to the general public, as well as to qualified naturalists. Properly shown and explained, they will have a very great educational value, and a healthy public opinion on such matters will be promoted.

Ultimately, every considerable natural history society should aim to have a reservation as its playground. It will be concerned with the following : administration, description, observations and records, research and experiment, propaganda and intelligence, and, as adjuncts, a museum of illustration and a reference library. It should be an obligation to use such areas properly to justify the annexation—otherwise it is hard to resist a frequent criticism of country folk, that it is only one more whim or vice of the idle rich, like game preserving ; that it means some curtailment of their liberties and should therefore be resisted.

Finally attention was called to a great desideratum, a journal (perhaps monthly), edited and produced in the best manner possible, and giving publicity to the movement and cultivating a good public opinion.

VIII

SOME EFFECTS OF THE CLOSURE OF THE NORTH SEA TO FISHING DURING THE GREAT WAR AND OF THE RESUMPTION OF FISHING

BY D. E. THURSBY-PELHAM

THE scientific history of the Great War of 1914-1918 has yet to be written in full. There can be no doubt that the immense increase in the amount of energy that was directed towards scientific experiment has had, and will continue to have, a very lasting effect on the future of the world. While the majority

of experiments were definitely planned, many were entirely involuntary, and of these there can have been no more gigantic experiment than the closure of a large part of the North Sea to fishing during the greater part of the period.

The extent of the closure was shown by charts issued by the Admiralty to fishermen during the war; roughly only a strip of the North Sea was left open, from Kinnaird Head to the Wash, and part of this was closed. Mine fields were a constant danger to the fleet, who fished towards the end of the war under the protected convoy system; before this was instituted many fishing vessels were lost. In addition to this curtailment some 3,000 fishing vessels were employed by the Navy for mine sweeping and other purposes, not only in the North Sea and round the British coasts, but also many went out to distant waters—the White Sea, the Adriatic, Suvla Bay, etc.—the losses both of ships and men were very heavy. On the eastern side of the North Sea fishing was confined to coastal waters in the vicinity of the belligerent and neutral countries.

It is difficult to estimate precisely the reduction in the total quantity of fish landed, compared with the average quantity taken before the war, since the statistics were not kept by some of the foreign countries and this article will be confined, therefore, to the figures afforded by the statistics of Great Britain.

Since Great Britain accounts for some 60 per cent. of the landings of fish, other than herring, from the North Sea, the figures give a very fair picture of the condition of affairs. This account, again, will only treat of "Demersal" fish, roughly those which live on or near the bottom of the sea, which are largely taken by the trawl, and not of "Pelagic" fish, such as the herring, mackerel, sprat, etc., which are principally captured by drift nets suspended in the upper layers of the sea.

The average quantity of demersal fish brought to port in Great Britain in each year during the years 1907-1913, was 3,857,021,000 cwts., and that of the last two complete years of fishing before the war, 1912-1913, was 3,504,273 cwts. From 1914 to 1918 only 8,454,285 cwts. (approximately) were landed, or an average for each year of 1,690,857 cwts. Therefore some 9,067,080 cwts., which would amount to many

billions of fish, were left in the sea by English vessels alone, which would otherwise most probably have been captured.

It was held by many authorities that man had no power to influence the productivity of the sea. The famous Belgian Naturalist, Van Beneden, laid down the principle that "The fecundity of fish is so great, the quantity of immature fish so small in comparison with the immensity of the sea, that it does not matter where or when the fishing is carried on or with what engines, man is unable to disturb the equilibrium which the Creator has established between destruction and reproduction—between life and death." The principle was held by Professor Huxley and the Government Administrators as far as the drift-net fishery and the cod fishery as then carried on chiefly by means of hooks and lines were concerned, some fifty years ago, and fortunately led to the abolition of many obsolete regulations which were imposed through ignorance of the life histories of fish. At the same time Professor Huxley admitted the possibility of the trawl-net fishery affecting the fecundity of the sea, though he has often been misquoted with regard to this point. The view that fishery of any kind has no effect is still held by Professor McIntosh, and is frequently quoted by those who are opposed to regulations proposed for the improvement of the Fisheries. It is difficult to see how this view can now be maintained when it was proved that after the war the sea was able to support nearly twice as many fish as had been allowed to grow to maturity before the war.

The question naturally arises, how do you know that there were more fish in the sea? To answer this it is necessary to explain the methods adopted by fishery research workers.

The actual abundance of fish cannot be judged accurately by the landings, since these, to some extent, depend on economic factors such as the demand, the possibilities of transport, the number of vessels fishing, etc. The Ministry of Agriculture and Fisheries has Collectors of Statistics at each port, who find out where each vessel has been fishing, and the amount of the catch of each kind of fish. Their returns are tabulated and are entered on charts of the North Sea, which are divided at the present time into rectangles of one degree of longitude and half a degree of latitude. Up to 1920 it was divided according to depths. Since the average length of each voyage

is known, it is possible to calculate the average catch of each type of vessel in each part of the North Sea, either according to "the day's absence from port" which was the standard used till recently, or "the catch per 100 hours fishing" which has been calculated during the last five years. It is obvious that according as to whether there is a greater or lesser amount of fish available for capture in the sea, the catch per days' absence, or per 100 hours fishing, will rise or fall. Different types of vessels have, as might be expected, differing catching capacities, and for our purpose of estimating abundance the catch of the first class steam trawler will be used, since this type of vessel lands 83 per cent. of the English North Sea catch of demersal fish.

The steam trawler catch per days' absence varied from 16.6 to 18.3 cwts. in the years 1906-1913. The mean catch of these years was 17.2 cwts. When fishing was resumed after the war it rose to 31.1 cwts. in 1919. The following table gives the

Catch per days' absence of Steam Trawlers in certain Years in the North Sea.

	1912	1913	1919	1920	1921	Mean 1912-13	Mean 1919-21
Haddock ...	4.69	2.99	15.84	10.91	9.70	3.84	12.15
Cod ...	4.45	4.40	5.18	5.58	5.04	4.41	5.27
Whiting ...	1.72	1.89	1.86	1.71	1.56	1.80	1.71
Hake ...	0.03	0.03	0.02	0.08	0.12	0.03	0.07
Ling ...	0.16	0.16	0.14	0.19	0.22	0.16	0.18
Coalfish ...	0.35	0.52	0.38	0.45	0.34	0.43	0.39
	11.40	9.99	23.42	18.92	16.98	10.07	19.77
Plaice ...	2.34	2.09	4.53	3.42	2.57	2.22	3.51
Soles ...	0.09	0.08	0.18	0.27	0.30	0.08	0.25
Halibut ...	0.03	0.02	0.02	0.02	0.02	0.02	0.02
Turbot ...	0.24	0.23	0.50	0.55	0.46	0.23	0.50
Megrims ...	0.03	0.03	0.00	0.00	0.01	0.03	0.00
	2.73	2.45	5.23	4.26	3.36	2.58	4.28
Total Demersal Fish ...	17.7	17.3	31.1	25.4	22.8	17.5	26.4
No. of days' absence ...	142,524	147,301	92,551	163,599	139,400	144,912	131,950

details of the catch per days' absence of the total demersal and of the more important fish. The number of days' absence from port of the vessels is also included lest it be argued that the decrease or increase depended entirely on whether there was a greater or lesser amount of fishing. This may have been

the case to some degree in 1919 when the fishing was below the pre-war standard, but since, in that year, the area of the operations of the fleet was still restricted to a considerable extent by the presence of mines, this is more apparent than real. Moreover, it does not account for the increased abundance in 1920 when the fishing had more than regained the pre-war intensity.

With the exception of haddock, the round fish show but little difference from the pre-war abundance, and that of whiting was rather lower in 1919 than in 1913. The figures of whiting, however, are not indicative, to all probability, of the actual takings, since this fish is of a low monetary value and, being human, the fisherman is apt to throw it away when he is getting a large quantity of more valuable fish, since it would tend to fill up the fish-hold with little profit. Haddock, again, must not be taken too seriously as it is always subject to violent fluctuations, probably due, according to the Scottish authorities, to the influence of good and bad years for the development of the eggs and larvae. It can be stated, however, that on the whole the average size of the round fish was much larger than before the war.

It is when we turn to the flat fish that the increase is really remarkable. The three most important flat fishes to the North Sea fishermen—plaice, sole and turbot—were twice as abundant in 1919 than they were in 1912 and 1913, and though the catch per days' absence in 1920 fell, roughly, a million cwts. more were landed in that year than in 1913.

From investigations carried on during the past twenty-five years it has been long evident that the flat fish are the most affected by the operations of man. Sole and turbot have not been studied to any great extent, but the life history and abundance of plaice have been the object of much investigation both in this country and by the fishery scientists of the other side of the North Sea, who have worked on concerted programmes under the auspices of the "International Council for the Exploration of the Sea." Since more is known about the plaice than any other fish, it will serve best to illustrate the effects of fishing. It is not, however, in quantity alone that the plaice showed so great an improvement in the immediate post-war years, the quality was infinitely superior. Before

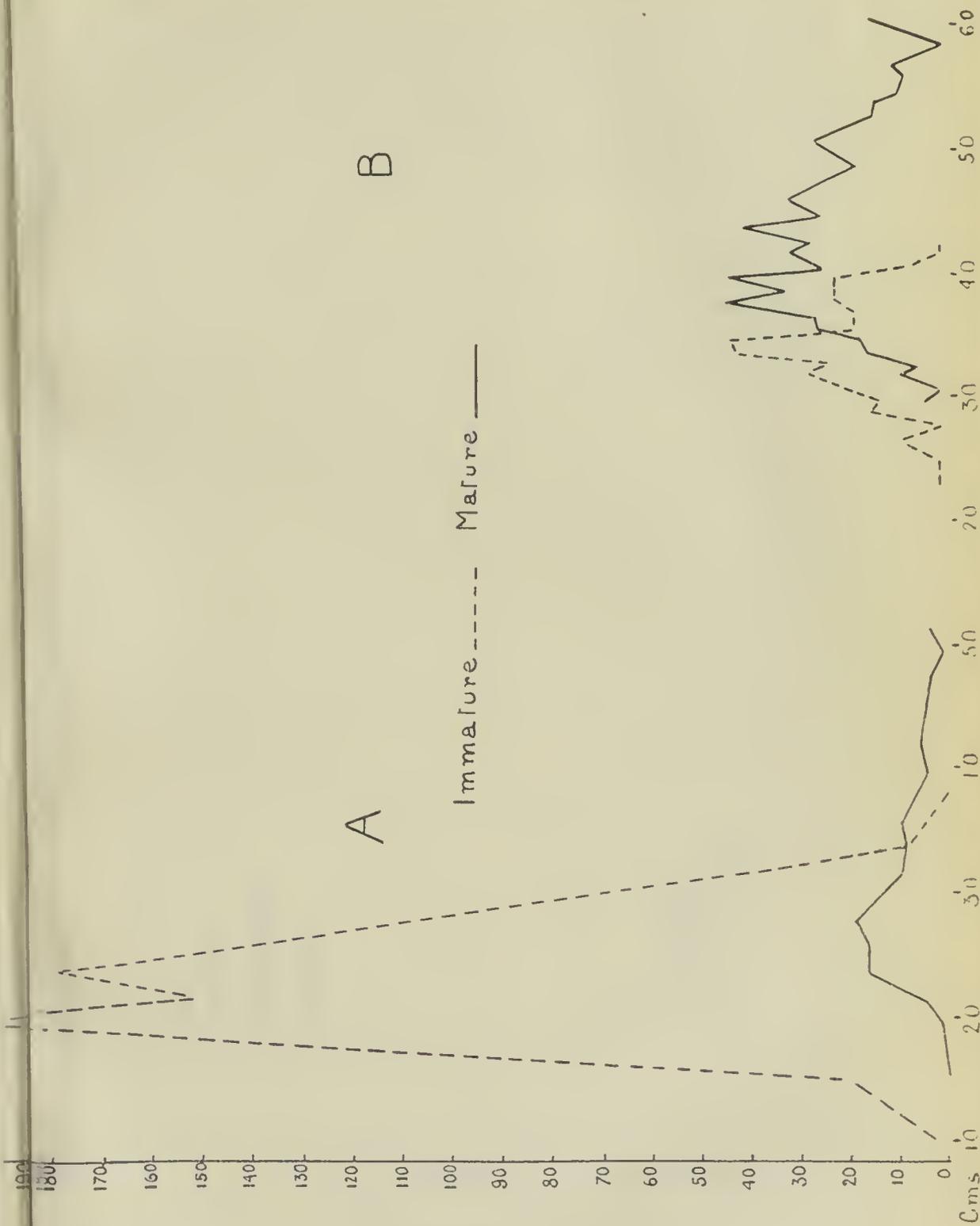


DIAGRAM 1

the war the vast majority of plaice caught in the southern North Sea was immature ; after the war the reverse was the case. This is illustrated in the accompanying diagram which shows the proportion per 1,000 fish of immature to mature in the Flemish Bight. A is from samples taken in the years 1907-1908 and B in 1920.

The difference is so striking as to make further comment unnecessary.

The statistics of the Market Categories " Large," " Medium," and " Small," show that the proportion per cent. of each category for the mean of the years 1906-1913 was " Large " 23.5 per cent., " Medium " 28.9 per cent., " Small " 42.4 per cent. and " Unsorted " 5.2 per cent., while in 1919 and 1920 respectively 37.8 and 41 per cent. were of the category " Large," 54.3 and 37.6 per cent. of " Medium " while only 7.5 and 14.8 per cent. were of " Small." These figures refer, of course, to the actual landings after any that were too small for the market were rejected on board ; measurements made on board commercial vessels are more strictly reliable since, not only do they refer to the whole catch but they have not been subject to alterations in the methods of sorting. The following diagrams of the proportion per cent. of each 5 centimeter group

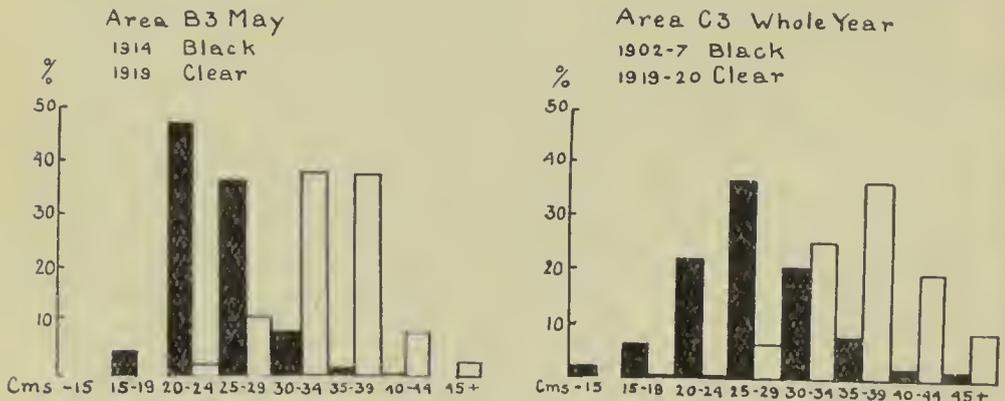


DIAGRAM 2 AND 3

taken from measurements made in two parts of the principal plaice grounds of the Southern North Sea (Areas B3 and C3) show the differences more exactly.

It will be noticed that while in May in B3 the majority of the catch in 1914 were between 20 and 29 cms, in 1919 the majority were between 30-39 cms ; the groups of the smallest fish, 15-19 cms, were not represented at all, and a very small proportion was in the 20-24 cms group.

C3, the principal spawning area of the plaice, where any big fish that may be present in the southern North Sea congregate during the winter for spawning, shows much the same picture. The average size of the plaice stock was 10 cms higher than before the war. The reasons for this are evident, the diminished fishing had given the fish the opportunity to grow up.

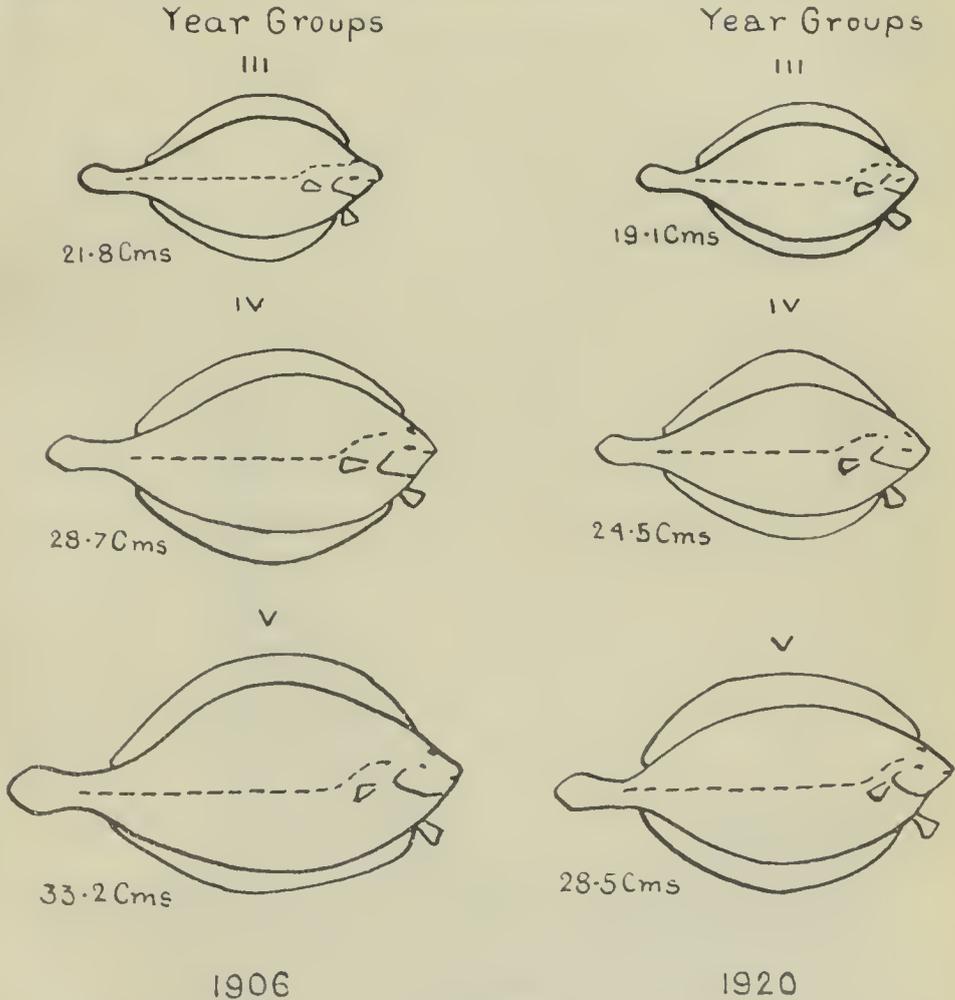


DIAGRAM 4

There was, however, a certain disadvantage connected with this immense accumulation of the older and larger fish, which was shown by Dr. Wallace in comparisons between the rate of growth of the pre-war and post-war plaice. He showed that the growth rate had slackened in the southern North Sea and that plaice of the same size were nearly a year older in 1920 than they were in 1906. This is shown in the accompanying diagram of the average length of the III, IV, and V. year groups of female Plaice in the two periods.

The following table shows the difference more exactly. It, and the diagram, are taken from samples trawled along the line of the outward spring migration from the Haaks Light vessel off the Dutch coast to the Leman ground.

AVERAGE AGE AT CERTAIN LENGTHS
MALES

Length in cms.	20	21	22	23	24	25	26	27	28	29	30
1906 ...	2.9	3.1	3.0	3.1	3.3	3.4	3.5	3.8	4.0	4.1	4.2
1920 ...	3.4	3.2	3.2	3.6	4.1	4.4	4.6	4.5	4.9	5.3	5.9
FEMALES											
1906 ...	2.8	2.8	3.0	3.1	3.2	3.2	3.5	3.9	3.8	4.0	4.0
1920 ...	3.4	3.8	3.9	4.0	4.0	3.9	4.7	4.6	4.9	5.0	5.4

The younger plaice, moreover, were not so far offshore as they were before the war, and the explanation given was that they were banked inshore owing to insufficient food available offshore, due to the presence of the enormous stock of older fish, and that being overcrowded, they had not enough to eat to enable them to grow rapidly. This would also account for the absence of the very small plaice in the catches in B3 and C3. Whether or no this was the whole story is now somewhat open to doubt, since subsequent investigations on the age and growth of plaice tend to indicate that other factors may play a considerable rôle in the growth rate.

This slackened growth rate was not common to the whole North Sea. Transplantation experiments made in 1920 to the Dogger Bank showed that there the plaice increased in size as rapidly as before the war despite the fact that the abundance was twice as great.

A still further effect of the increase of the mature plaice was shown by English and German investigations on the number of plaice eggs spawned in the great spawning area of the Southern Bight. It was estimated that the number of eggs spawned in 1920 was more than twice that of 1914.

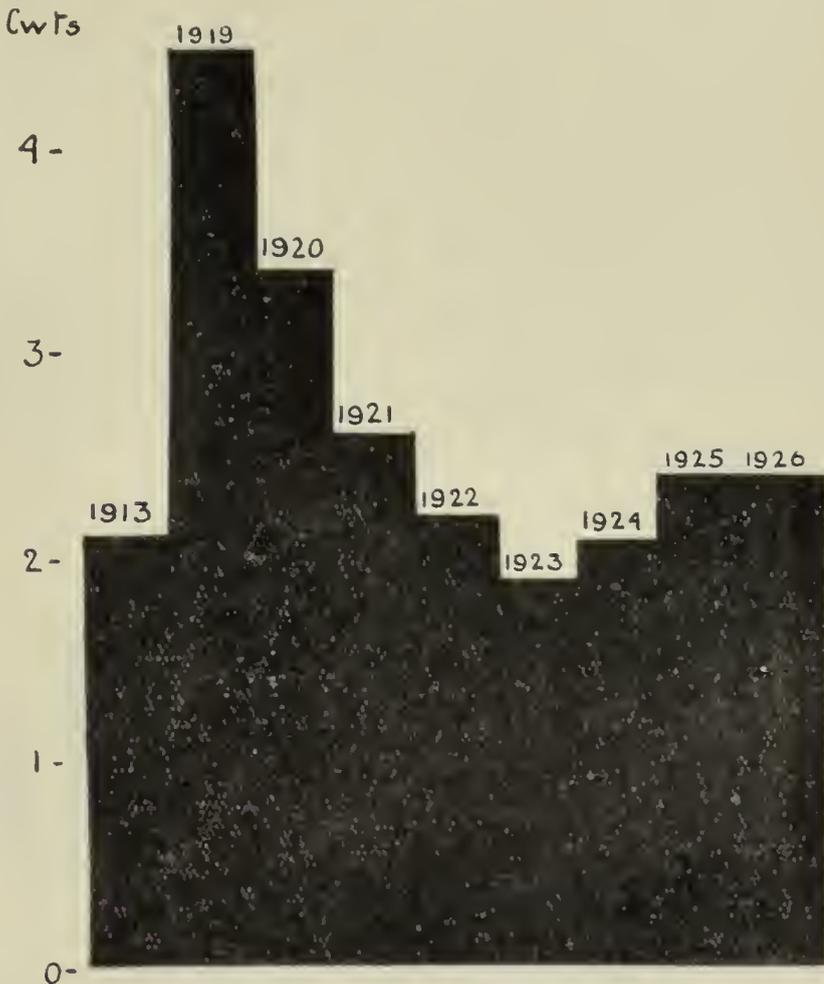
SUBSEQUENT HISTORY

The prospects of the North Sea fishermen were very bright in the years immediately after the war. The sea was teeming with fish of large size and of high value. Large quantities of money were invested in fishing and the number of vessels increased rapidly. For three or four years all went well, then came the decline. That this was swift and great is shown

by the following figures for the average catch in cwts. per days' absence by steam trawlers.

	Cod.	Haddock.	Plaice.	Soles.	Turbot.	Total Demersal.
1913 ...	4.4	3.0	2.1	0.1	0.2	17.3
1919 ...	5.2	15.8	4.5	0.2	0.5	31.1
1920 ...	5.3	10.9	3.4	0.3	0.5	25.4
1921 ...	5.1	9.6	2.5	0.3	0.5	22.8
1922 ...	3.9	8.5	2.2	0.3	0.4	19.5
1923 ...	2.5	5.4	1.9	0.2	0.3	14.2
1924 ...	2.6	4.8	2.1	0.2	0.3	14.5
1925 ...	3.5	8.5	2.3	0.1	0.3	18.4
1926 ...	4.2	8.2	2.3	0.1	0.2	19.4

Plaice, which, as already stated, were the most affected by the closure, were the first to show the effect of the resumption of fishing. The following diagram makes the extent of the rise and fall in abundance clear.



Catch per Day's Absence (cwts) of Plaice
1st Class Steam Trawlers.

DIAGRAM 5

In 1923 the average catch fell to below the low level of 1913 and, although it rose during the last two years, it cannot be said to be satisfactory. There is certainly no numerical scarcity of plaice in the sea, but the average size of the fish has fallen to the pre-war level. The proportion of each trade category for the last seven years is as follows :—

	Quantity in Tons.			Proportion per cent.			
	Large.	Medium.	Small.	Large.	Medium.	Small.	Unsorted.
1920 ...	13487	12377	4880	41.0	37.6	14.8	6.5
1921 ...	6168	11047	5703	26.1	46.7	24.1	3.0
1922 ...	4750	9710	10518	18.7	38.2	41.3	1.8
1923 ...	3217	6088	12384	14.3	27.1	55.2	3.3
1924 ...	2329	4998	13516	10.5	22.6	61.2	5.7
1925 ...	1744	3566	16149	7.6	15.5	70.4	6.5
1926 ...	1264	3052	13808	6.6	15.9	71.9	5.6

It is very evident that the more valuable fish are very scarce and that there is a very large quantity of the more unremunerative sizes.

The measurement of plaice on board commercial fishing vessels has been continued on a large scale, from nearly two hundred to three and a half hundred thousand having been measured by the Ministry's staff in each year. The decline in size of the plaice caught has been continuous and the average size is now much the same as it was before the war. This is illustrated by the following diagram of the proportion

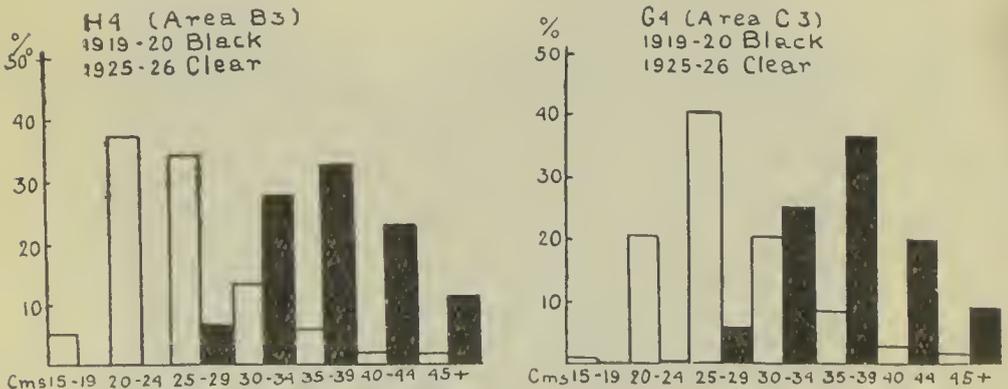


DIAGRAM 6 AND 7

per cent. of each centimeter group taken from samples trawled in the same areas as those shown in the previous comparison of pre- and post-war fish.

This, of course, only deals with a small section of the North Sea, but it is common to the whole of the main plaice grounds. The effect of the decline in size has been that many plaice are caught that are too small for commercial purpose and millions are thrown overboard either dead or dying in the course of the fishing. It is not the purpose of this article to enter into the commercial aspect, but at the same time it is of interest that the number of hours' fishing has dropped from 2,254,120 in 1921 to 1,950,881 in 1925, and that this decline is due in the main to less fishing in the regions where the plaice fishery is principally carried on.

Soles also show a decrease of the larger sizes ; in 1920 the proportions of the trade categories were as follows :—“ Large ” 68 per cent., “ Medium ” 12 per cent., “ Small ” 16 per cent., and “ Unsorted ” 3 per cent. In 1926 the “ Large ” had fallen to 40 per cent. and “ Medium ” and “ Small ” had risen to 23 per cent. and 29 per cent. respectively.

To turn again to the growth rate of plaice. The line of stations from the Haaks Light Vessel to the Lemn Ground, which have already been compared for the pre- and post-war growth rates, has been trawled in every year since 1922 by the Ministry's research vessel, and collections of otoliths of every plaice caught have been made. As we have already seen, the large fish have disappeared to a considerable extent. The young fish too have moved offshore, indeed they are found further out to sea than in 1906, but the growth rate still remains much below the pre-war level. What the causes of this slow growth may be, are as yet unknown. It is possible that it is still affected by the war in that there were more mature spawning fish, certainly up to 1923, than before the war, which might increase the number of plaice on the inshore grounds. Incidentally it may be stated, however, the winter of 1923 was evidently unfavourable for the development of the eggs and larvæ, as very few of that year-class are present in the North Sea in 1926. Nevertheless, on the whole, the catch of plaice along the line of stations was greater, numerically, from 1923 to 1926 than before the war, and although it has recently consisted of very small fish, the food supply may have been insufficient for a rapid rate of growth in this area. The plaice of the eastern grounds north of Heligoland, as shown by German investigations, and

by the English research work carried out in the early summer and late autumn of 1926, showed a rapid growth, and as far as can be judged by the somewhat sparse data of the English, Danish, and German investigations, were more abundant than on the grounds off the Dutch coast. This would lead one to suppose that other factors besides overcrowding have considerable influence.

The whole question of the causes affecting the growth rate are still conjectural and many causes may be at work. For example, it may be influenced by hydrographical conditions causing fluctuations, not only in the development of the fish but in the supply of food available; or by competition with other species which eat the same food, such as the haddock, which, as we have already noticed, is subject to violent fluctuations. Recent work tends to show the matter is one which requires further research.

To elaborate further the effect of the cessation and resumption of fishing would be tedious. Should anyone wish to study it in greater detail they can refer to the Ministry's publications on the subject in the accompanying list. The paper published by Mr. J. O. Borley and the present author in 1925 gives a comprehensive bibliography.

Enough has been said to give an outline of the changes in abundance and size of the stock of the principal flat fish. The effect of natural fluctuations have not been dealt with, and although recent investigations have thrown some light on these, in the case of the plaice they tend to prove that while the productions of the young stock may vary from year to year in amount, they have not so far-reaching an effect as the agency of man.

The reason for the omission of the effect of the war on the herring must be given. The quantity of herrings fished for and landed is almost entirely an economic one. The great majority of herrings caught are not consumed in this country but are salted and exported to Russia, Germany, Poland and other countries. When, as has been the case in recent years, the demand has diminished owing to the unsettled financial conditions, a very much smaller quantity of the fish caught is saleable. It is therefore impossible to say whether the war resulted in an increased supply. The

export of herring at the present time is still below the pre-war level.

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IX

WILD BIRD PROTECTION IN NORFOLK IN 1927

REPORT OF THE COMMITTEE

ALTHOUGH, from a climatic point of view, 1927 was one of the worst summers experienced in Norfolk for very many years, yet, from the point of view of wild birds (excepting game-birds), the effects upon reproduction were not nearly so disastrous as might have been expected. Birds nesting on exposed foreshores are always subject to unexpected dangers in the shape of high tides, gales of wind, etc., but this year very few nests were washed out on the Norfolk terneries; and although there was an almost unprecedented amount of wind during the period of incubation, the blowing sand, one of the deadliest enemies to terns' eggs, was, owing to the excessive rainfall, a factor of no very serious import.

For purposes of classification, birds of Norfolk may be divided into: (1) Shore birds; (2) Broadland Birds; (3) Upland birds; (4) Breckland birds. As regards the first the committee has their protection during the breeding season well in hand, and the two principal nesting areas on the coast, namely, Blakeney Point and Scolt Head Island, have been secured as Nature Reserves for all time.

Perhaps the most important district in the county, from the point of view of rare nesting birds, is Broadland. Here the Committee has no direct control, nor, indeed, is any such needed so long as the ownership of this part of the county remains in the hands of as good naturalists and sportsmen as at the present time.

As regards what may be called the Upland birds, there are so many commons, parks, and other enclosures in the county, and such a plentiful food supply for all seed-eating birds in the arable fields and gardens, that there is no fear on their account. But, for the fate of the Stone-curlew in Breckland, its chief stronghold in England, the Committee has anxiety. From the recent correspondence in the "Times," it will have become widely known, how, by their planting, the Forestry Commissioners are entirely altering the face of this part of Norfolk, and

unless a considerable area—at least 1,000 acres—can be secured and allowed to remain as uncultivated breckland, it is only a question of time before the Stone-curlew is driven, as was its larger relative, the Great Bustard, from those glorious heaths to which for untold centuries it has so regularly returned to nest. Norfolk naturalists are aware of this danger and are taking steps to try to avert it.

BREYDON

It is with much regret that the Committee has been obliged to accept, on the score of health and age, the resignation of George Jary, who was held the post of watcher on Breydon for the past twenty-five years. During the past summer, except for about three weeks when he was laid up, Jary was able to continue at his post, living in the Committee's houseboat on Breydon Water; but he now feels that he is not strong enough to face the exposure. The Committee wishes to record here its appreciation of his loyal service. A successor will in due course be appointed.

As will be known to most of our subscribers, Breydon Water is an extensive estuary, on which at one time indiscriminate shooting used to take place at all seasons of the year. It is not a nesting ground, but it is the port of call of many migrants, especially waders, during the migration seasons. It was here that Booth obtained a large number of the birds now in the Dyke Road Museum. For several years it has been visited by Spoonbills during the summer months—birds that fly over from one of the nesting colonies in Holland. Now, the Spoonbill is one of the birds that we hope to regain in Norfolk as a breeding species, and one of the objects of having a watcher on Breydon is to ensure that these visitors are not molested.

The earliest reference to the Spoonbill breeding in Norfolk is contained in a document bearing date 1300, where reference is made to the harrying of the eyries of the "Popeler" or Shovelard at Cantley and other places in Norfolk. Sir Thomas Browne (1605 to 1682) makes reference to "the platea or shouelard, wch build upon the topps of high trees. they haue formerly built in the Hernerie at claxton and Reedham now at Trimley in Suffolk. they come in march & are shot by fowlers not for their meat butt the handsomeesse of the same, remarkable

in their white colour copped crowne and spoone or spatule like bill." There are still from 80-100 herons' nests at the Reedham heronry, which is within sight of Breydon. What a rare sight would be this ancient heronry once again tenanted by the handsome Popelar with its "white colour copped crown and spatule like bill."



Roland Green.

On the afternoon of June 14th a White Stork came to Breydon and remained till dusk, but this rare visitor departed during the night, and was not seen again.

CLEY AND SALTHOUSE

In our last Report reference was made to the recent purchase of the 407 acres of the Cley marshes as a bird breeding Reserve. The property has since been handed over to the Norfolk

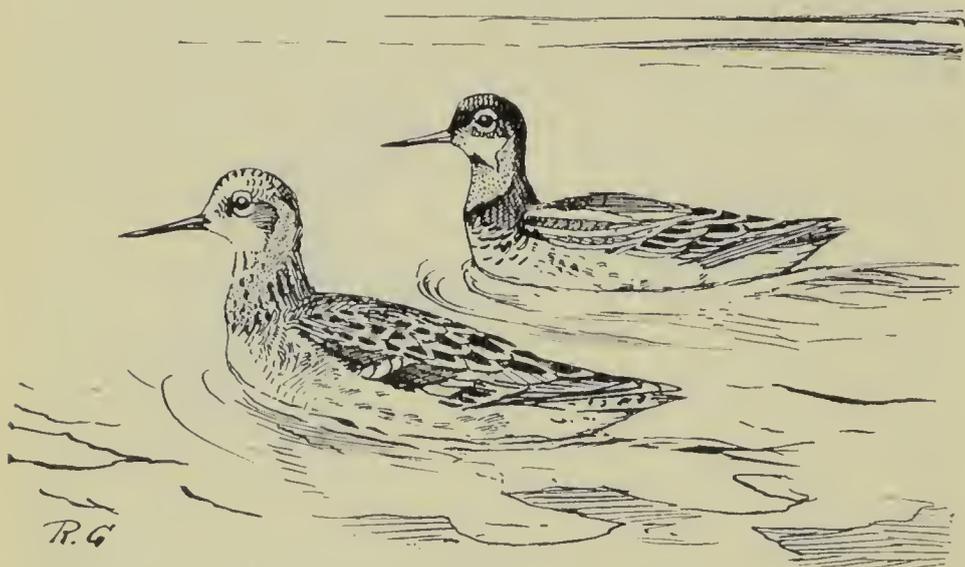
Naturalists Trust, which body will hold it as such for all time. Robert Bishop, of Cley, has been appointed Watcher, and he was on duty throughout the year.

To give the fullest encouragement to birds intending to nest, the marshes were left undisturbed between February 15th and September 15th. However, from the point of vantage of the East Bank an uninterrupted view of the whole area is obtained, so that one has a fairly good idea of its bird population during most of the year. On the other hand, as no census of nests was made, it is possible that some species may have escaped observation. At all seasons of the year there is usually something of interest to be seen by the bird watcher stationed on the East Bank, and during the past twelve months advantage of this has been taken by a large number of ornithologists. It is a pleasure to be able to record the fact that on no occasion has any visitor attempted to disregard the instructions of the watcher.

A certain number of ducks, principally mallard, teal and shovelers, are known to nest on the marsh, as also do a large number of Redshanks and Green Plover. A large and increasing number of Sheld-ducks nest on the inland heaths, and they bring their young to the marsh as soon as hatched. Indeed, the numerous Sheld-ducks to be seen on the marsh in the spring is one of its chief ornithological features; on April 3rd the writer counted 55, and there were several others hidden from view by reeds, etc. On May 26th he found the first Sheld-duck ducklings, then about five days old.

Perhaps the most interesting birds seen on the marshes during the year were a Bittern, on February 15th and 18th; a Spoon-bill, which arrived on April 6th and stayed, with an interval of about a week, until the beginning of August; for a few days in the second week in July it was joined by a second bird. On June 5th a female Red-necked Phalarope, in perfect nuptial plumage, arrived on the Salthouse side of the East Bank; on the night of the 6th it was joined by a male, and both birds moved on the following night. They were seen by several ornithologists. Black Terns were seen passing through in May, and again in August and September; and in the latter month an unusual number of Greenshanks were to be seen and heard about the marshes.

No terns nested on the Cley marshes this year, but there was a good colony on the Salthouse marshes on an island about 300 yards from the East Bank. On June 6th Miss Barclay-Smith and the writer counted 200 nests of the Sandwich Tern on this island; one of these had three eggs, sixty had two eggs, and the remainder one egg. On the same island there were seventeen nests of the Common Tern and twenty-five of the Black-headed Gull. On the adjoining marsh belonging to the Norfolk County Council Mr. Yeo counted 201 nests of the Common Tern on June 3rd.



RED-NECKED PHALAROPES (*see page 339*)

The first Sandwich Tern's egg on Salthouse Broad was found by the keeper, Holman, on May 15th, and on June 15th the first chick was hatched. During the cold, rainy weather of the latter half of June many of the young succumbed, and on the 30th Holman found forty dead Sandwich chicks, and many of the Common Terns' nests had been washed out. After this the weather improved and, considering the season, the Salthouse birds did well.

During the year a much-needed shelter, a shepherd's hut, has been supplied for the Cley watcher.

BLAKENEY POINT

On an exposed area like Blakeney Point a calm, still day is rarely experienced: there is nearly always a wind, and a wind

of considerable force. Such winds always seem to depress and demoralise most passerine birds and it is generally hopeless to go bird watching ashore under such climatic conditions. Not so with sea-going birds, such as terns and gulls; they would seem to revel in a good breeze, and were it otherwise they would certainly not select such a wind-swept area as the Far Point on Blakeney Point for purposes of nesting. It is a little difficult to realise this sometimes, as it was for the writer when staying on the Point between the 11th and the 19th of June of this year, during which week there were not five minutes of calm, and on most days so cold a wind that winter clothing had to be worn. The terns were all sitting, but the prospects of any eggs hatching out seemed small, especially after one night's deluge of rain with very high wind. On the top of a ridge of shingle between the two main terneries an Oyster-catcher was incubating her four eggs in a mere depression in the stones, and exposed to all the fury of the gales and rain. So suspicious was she of human beings that she would leave her nest when anyone approached within a quarter of a mile of her, and during that week she must have been put off dozens of times by visitors to the ternery. In due course all the eggs hatched out!

As regards the terns, the point of special interest this year at Blakeney was the large breeding colony of Sandwich Terns; there must have been upwards of 500 nests of these birds on the Far Point. On one small area, four yards by three, there were forty-two nests, and the eggs presented great varieties in coloration. Of Common Terns there were about the usual number, but in the Long Low colony the nests were more distributed in the dunes than is usual.

Two nests of the Roseate Tern were identified; the one on the Far Point, very near to where there was a nest last year; the other, discovered by Mr. Stuart Baker and Mr. Coltart, "on the beach just inside the hillocks on the outer side of what Pinchen calls the 'big low.' There were two eggs quite typical of the species, small and speckly, and we watched the tern twice down on to the nest." For the greater part of each day the mate of the sitting bird on the Far Point was to be found resting on the sand within a few feet of the nest. Both of these nests hatched off successfully.

When looking at a large number of terns in the air, such as can be seen on Blakeney Point, one often sees a distinct pink colour on the breast of birds which are not Roseates, and that this is not always imaginary on the part of the observing eye was proved to the writer this year. A Sandwich Tern showing no trace of injury was picked up dead on the sands, and when the feathers of the breast of this bird were slightly separated and looked at from a certain angle the all-white colour was replaced by a very distinct pink.

A few pairs of Arctic Terns were identified, as usual, in the colony, and the writer watched one bird on to its nest. Forty-two Little Terns' nests were found by Pinchen on the shingle ridge between the two main nesting grounds.

On June 16th a tour was made of the ternery on the Far Point. During the night the wind had shifted from the north east to the south, with a consequent rise of several degrees in temperature, though it was still blowing strong. The first Sandwich Tern chick of the year was found, and there were a few of the Common Tern, which had been hatched the previous day. After this date hatching proceeded apace. As an indication of the kind of weather prevailing at the time, it may be mentioned that on June 19th, owing to a strong S.W. gale, it was impossible to cross to Morston by boat, so that two friends of the writer who had to return to London that day were obliged to walk to Cley, somewhat heavily laden with cameras and other impedimenta.

As has often been observed, terns, and especially the Arctic, will boldly resent intrusion upon their nesting ground, and as an example of such pugnacity it may be recorded that on one occasion during his visit to the Point this summer the writer was attacked from behind by a stooping bird which struck his uncovered head, though it failed to draw blood.

Despite the execrable weather during the whole of the incubation period the Sandwich terns on Blakeney Point had a good hatching; and towards the end of July and in early August it was most interesting to watch the regiments of young birds parading the nesting ground. They strutted about in companies of from 50 to 200 strong, and were a source of much amusement to visitors. The Common Terns did not fare quite so well; indeed, owing to blowing sand, many



Photo

A Company of young Sandwich Terns on Blakeney Point, August, 1927

F. W. Oliver



Photo

Sandwich Terns on and above their nests on Blakeney Point, 1927

F. W. Oliver

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of the first eggs became clogged during the hatching of the chicks, among which there was a high mortality. But in a large number of cases second clutches were laid, which hatched out and the young reached the stage of flight.

There were seven Oyster-catchers' nests on the Point this year; three on the Yankee ridge, two on the Hood, one on the Beachway and one on the shingle ridge leading to the Far Point. All these nests hatched off.

Six nests of Redshanks were found, one of these being placed, as last year, in the grass on one of the diminutive dunes on the Far Point, in the middle of the ternery.

PROSECUTION FOR TAKING TERNS' EGGS ON BLAKENEY POINT

At the Holt Petty Sessions on July 8th, 1927, John Cuthbert Worley, of 15, Sandown Road, Leicester, described as a dealer in eggs, was summoned for taking six Common Terns' eggs on Blakeney Point on June 6th. His mother and an employee, William Freer Sharp, of the same address, were summoned for aiding and abetting. Mr. H. O. Brown, Deputy Clerk to the Norfolk County Council, prosecuted, and defendants did not appear.

Evidence was given by Captain Lloyd that on Bank Holiday June 6th, when assisting Pinchen in his work as watcher on the Point, he saw the three defendants walking in line over the Old Ternery and obviously looking for nests. He saw John Worley pick up something which he put into his cap, and stoop again to pick up something further on, which he transferred to his pocket. On going up to him Capt. Lloyd found that he had in his possession two clutches, each of three eggs, of the Common Tern. One clutch was replaced in the nest from which it was taken; the other was produced in Court. Capt. Lloyd explained to the Bench that there were notices on the Point stating that eggs must not be taken, nor the birds disturbed during their nesting. The Chairman of the Bench (Mr. W. Towler) said the magistrates were determined to stop this interference with the protection given at Blakeney, and that the defendant Worley would be fined the maximum penalty of £1 for each egg taken, or £6 in all; and the other two defendants £1 each for aiding and abetting. The eggs were confiscated by the Court.

SCOLT HEAD ISLAND

The importance of Scolt Head Island as a breeding area and as an observation station for migration is becoming more obvious as evidence accumulates. With its extensive dunes, shingle beaches, and salt marshes and large feeding-grounds for waders the possibilities for attracting birds are great. The experimental planting of shrubs on certain selected spots on the island for the attraction of passerine birds is being proceeded with, and during the year considerable progress in this direction has been made.

This island and Blakeney Point would seem to offer alternative nesting sites for the large colony of Sandwich Terns that have come to Norfolk during the past few years, and during 1927 most of these birds nested at Blakeney.

The first terns were seen, off the Lynn Well Lightship, on April 9th, and a week later nine Sandwich Terns were seen off the island. On the 19th the first Common Terns arrived.

On July 3rd, the first warm sunny day after a fortnight of wet weather, we made an inspection of the island. There were twenty-one Sandwich Terns' nests containing twenty-five eggs. Common Terns' nests were numerous, and the watcher, Charles Chestney, reported that he had counted 584. Many of these eggs became choked with blown sand during hatching, but in a number of instances second clutches were laid, and on August 1st we counted 100 nests containing, mostly, two eggs. Although a large number of the first hatched chicks died from cold and blown sand, these second hatchings were mostly reared.

There was an unusually large number of Little Terns nesting on the island this year, and the watcher counted over 100 nests. Twenty-nine nests of Redshanks were found, and over 100 nests of the Ringed Plover.

There were fourteen Oyster-catchers' nests, all of which hatched off. In two instances a high tide washed the eggs out of the nests, where they remained for some hours before being discovered and replaced by the watcher; and as late as August 1st one clutch of three eggs was still being incubated.

It is impossible to estimate with accuracy the number of Sheld-ducks that nest on the island, but on March 4th the watcher counted fifty that were apparently inspecting rabbit holes.

Short-eared Owls did not nest on the island this year, but their nest of last season with an unhatched egg in it was discovered by Chestney. At frequent intervals between January and May one or more Short-eared owls were seen.

In previous Reports reference has been made to the large number of Swifts that pass from east to west along the north coastline of Norfolk during both the spring and autumn migration, and when staying on Blakeney Point between June 11th and the 19th such a movement on a considerable scale was observed by the writer on almost every day. Whether these birds were on their way to, or were returning from, the north, it was impossible to say. When one watches these birds migrating against a strong head wind one feels that occasionally they must need to rest, or, at any rate, the least vigorous of them; but if so, where do they rest? In this connection it is interesting to record the fact that on a day about the middle of August Chestney found a Swift clinging by its claws, in a vertical position, to the exposed roots of marram grass in the wall of a blow-out in the dunes. The bird allowed him to pick it off by his hand, and when he tossed it into the air it flew off and immediately started catching insects. Within a day or so of this he found two Swifts lying on the shore with outspread wings, the one dead, and the other at its last gasp. Neither of the birds appeared to be injured in any way, and one can only conclude that they had dropped from exhaustion. Such must be the fate of a large number of migrating birds.

Unusual migrants are occasionally seen, and amongst these may be mentioned five Crossbills seen at close quarters by the watcher on July 20th. The birds were hanging on ragwort stems. About the same date Dr. Sumpter saw three Crossbills in his garden at Brancaster Staithe. These birds were doubtless part of the large immigration that came to England during this summer.

During the latter part of August and the first ten days in September there was a very large number of Pied Flycatchers and Common Redstarts on the island. These two species were

also very numerous about Cley and on Blakeney Point ; so much so that 1927 will undoubtedly be remembered as a Pied Flycatcher year.

WOLFERTON

As foreshadowed in last year's Report, the Committee has reluctantly come to the conclusion that it is futile any longer to try to protect the rapidly diminishing colony of terns that still cling to this nesting ground, and in taking this step it has the approval of His Majesty the King, who has the sporting rights over the area.

A few terns arrived in May, but they nearly all moved on—probably either to Scolt Head Island or to Blakeney. We visited the ground on May 15th, when we found but two Common Terns and a few Little Terns, and the keeper had found only two nests. A gang of men were at work transferring shingle to a beached ship, and we were informed that this work was going on every day so that the birds were constantly being disturbed. It is to be regretted that this, one of the first breeding grounds to be protected in Norfolk, should, literally, be removed for road-making and building purposes.

RARE BREEDING BIRDS

Although the Woodcock is known to nest in many parts of England it is not often that its eggs are found in Norfolk. It may therefore be recorded that a nest containing four eggs was shown by a keeper to Dr. A. H. Evans at Didlington on April 29th. The eggs were stone cold and the nest obviously deserted, and under these conditions the keeper allowed Dr. Evans to take the eggs, two of which he gave to the writer for the Norwich Castle collection, and the others he presented to the collection at Cambridge.

A pair of Magpies nested and hatched off in a wood in the Broads district, and another was seen several times during the first two weeks in May on a north Norfolk heath. A careful search for the nest of this bird was unsuccessful. Except on the western borders of the county a Magpie is rarely seen in Norfolk in these days.

In the ruined masonry of the old paper mill at Taverham a pair of grey Wagtails nested again this year.

For the past two years Hooded Crows have undoubtedly nested at Winterton, though a nest has never been found. On June 29th of this year, and before the eclipse had entirely passed off, we saw a pair of Hoodies with three young ones on the dunes bordering Winterton Warren. These young birds must have been hatched somewhere in the immediate neighbourhood.

Although the Tufted Duck, like the Gadwall, has been steadily increasing in numbers in West Norfolk for some years, it is very rarely that this species has been suspected of nesting in the Broads district. We know of but two instances; at Hickling, in 1912, a nest was found, which was afterwards deserted; and at Salhouse, in 1913, a brood was seen on the river Bure. It is therefore now worth recording that, although the nest was not found, there is no doubt but that a pair of Tufted Ducks bred on Alderfen Broad this year. On June 1st Mr. Callow saw a female with seven young, swimming on the Broad, and he considered that the ducklings were not more than twenty-four hours old. On the 9th the writer was taken on to the Broad by Mr. Goodchild, and saw the female Tufted Duck with two ducklings; the other five, as was eventually the fate of the remaining two, had been killed by either pike or otter.

From reliable sources of information and from our own observations we can assure our supporters that the Bittern is continuing to receive adequate protection. The problem is, what happens to all the young Bitterns that are annually hatched in Norfolk? If they remained to breed in the county then, by this time, all suitable nesting areas would be occupied, but such is not the case; indeed, the breeding range is very circumscribed, although there are plenty of reed-beds in other parts of the county which as yet remain untenanted.

After being nearly wiped out in the winter of 1916-17 the Bearded Tit is now almost one of the commonest birds in certain parts of Broadland. During the past season they seemed to be very prolific, and, in certain areas, might now be described as numerous. As will be known to readers of these annual reports, a certain number of Montagu Harriers usually nest in Norfolk, but during this past year only one nest was found

and it is unlikely that there were others, at any rate in the immediate neighbourhood of this nest.

The Marsh Harrier is one of the rarest nesting birds in Norfolk. and until this year an interval of six years has elapsed since the last nest was found. At the beginning of May three females and a male were frequently seen, the former being easily identified as they all varied slightly in plumage. In due course a nest was found, and the precaution was taken of having it watched night and day by two special watchers. After sitting for two weeks the bird left the nest early on the morning of May 30th and never returned to her three eggs; when examined, these were all found to be infertile. Suspicion had been aroused that she was an unmated bird, as the male had never been seen bringing food to her.

MR. N. TRACY'S BIRD NOTES

Mr. Tracy reports that for the first year since 1918 he failed to discover any Crossbills' nests in his district—near King's Lynn—this year. However, on July 20th he found a flock of eight feeding on cones in his wood, and a little later heard "several small parties flying over." It was at this time (July 20th) that Crossbills were seen on Scolt Head Island.

It is very satisfactory to hear from Mr. Tracy of the increase of the Wood-Warbler in that part of Norfolk, and also of the Nightingale. He says: "There were about eleven pairs of Nightingales and ten pairs of Wood-Warblers within a radius of about one-third of a mile of my wood," and in a wood at Snettisham he located six pairs of Wood-Warblers. From our experience this species is more generally distributed in Norfolk than is commonly supposed. Speaking generally, Mr. Tracy says there seemed to be an increase in the number of Willow-Wrens, Chiff-Chaffs, Wood-Warblers, and Nightingales; whereas Cuckoos, Tree Pipits, Yellow Wagtails, Black-caps and Turtle Doves seemed scarcer than usual.

The following is a list of the birds that nested in Mr. Tracy's wood this year, with the number of nests of each species. As compared with last year's list there is an increase of thirty-two nests, with the addition of the Pheasant and House Sparrow as new-comers.

	Nests.		Nests.
Blackbird ...	5	Wood Pigeon ...	6
Song Thrush ...	9	Stock Dove ...	1
Mistle Thrush ...	13	Turtle Dove ...	1
Wren ...	4	Starling ...	3
Robin ...	7	House Sparrow ...	1
Goldcrest ...	3	Nuthatch ...	1
Chaffinch ...	20	Tree Creeper ...	7
Great Tit ...	6	Spotted Flycatcher ...	5
Blue Tit ...	5	Pheasant... ...	4
Cole Tit ...	2	Willow Wren ...	7
Marsh Tit ...	1	Lesser Redpoll ...	4
Long-tailed Tit ...	1	Common Redstart ...	5
Pied Wagtail ...	2		—
		Total ...	123

Bird Protection in Norfolk, as elsewhere, is a problem beset with many difficulties, which can only be surmounted by experience and the expenditure of money. The former is being gradually accumulated; the latter we hope will be forthcoming from those who are in sympathy with the Committee in its work. There is much yet to be done, and it is hoped that all into whose hands this Report may fall will support the Committee with a subscription.

Signed (on behalf of the Norfolk W.B.P. Committee),

SYDNEY H. LONG, *Hon. Sec.*

LIST OF SUBSCRIPTIONS AND DONATIONS TO THE NORFOLK WILD BIRDS PROTECTION FUND FOR 1927

	£	s.	d.		£	s.	d.
H.M. THE KING ...	3	3	0	Brought forward ...	16	10	0
H.R.H. THE PRINCE OF WALES, K.G. ...	2	2	0	Barclay F. H. ...	1	0	0
Adam Miss H. ...	1	1	0	Barclay H. G. ...	2	2	0
Adcock E. D. ...	1	1	0	Barnard Mrs. ...	1	1	0
Agnew C. G. ...	1	1	0	Barrow Miss ...		10	0
Allars R. W. E. ...	3	3	0	Barry T. H. ...	1	1	0
Allen J. L. ...		5	0	Barry W. J. ...	1	1	0
Allen J. W. ...	1	1	0	Barton S. J., M.D. ...	1	1	0
Andrews W. H. M. ...		10	0	Bedford Her Grace the Duchess of ...	2	2	0
Baker E. Stuart ...	3	3	0	Bevor Sir Hugh, Bart. ...	2	2	0
Carried forward ...	16	10	0	Carried forward ...	£28	10	0

	£	s.	d.		£	s.	d.
Brought forward ...	28	10	0	Brought forward ...	87	16	1
Bell J. H. ...		10	0	Ennion E. F. R., M.R.C.S., L.R.C.P.		10	6
Bidwell E. ...		10	0	Ferrier Miss Judith ...		10	0
Blakeney Point Col- lecting Box ...	1	16	0	ffolkes Sir W., Bart. ...	1	1	0
Boardman E. T. ...	1	0	0	Friedlein W. ...		10	6
Boileau Sir M., Bart.	1	1	0	A Friend ...		10	0
Brash T. ...	2	2	0	Gadesden Miss ...		10	6
Brereton Miss E. D.	2	0	1	Gayner Dr. J. S. ...	1	1	0
Brittain H. ...	1	0	0	Gay Miss C. E. ...	1	1	0
Brooks J. R. ...	1	1	0	Giles C. C. T. ...		5	0
Brown E. ...	1	1	0	Glanville J. P. ...	1	1	0
Brown H. ...	1	1	0	Glegg William E. ...	1	0	0
Buckle Lt.-Col. D. W.	1	1	0	Goddard W. N. ...		10	6
Budd C. ...		5	0	Gossage Col. W. W. and Mrs. ...	2	2	0
Bullard Ernest ...	1	12	0	Gowen H. P. ...	1	1	0
Burrowes R. B. ...	1	0	0	Graves Mrs. ...	1	1	0
Burton S. H., F.R.C.S.	2	2	0	Gurdon E. T. ...	1	1	0
Butcher R. W. ...	2	0	0	Gurney G. H. ...	2	2	0
Buxton E. G. ...	2	2	0	Gurney Q. E. ...	1	1	0
Buxton G. F. ...	3	3	0	Gurney R. ...	1	1	0
Buxton W. L. ...	1	1	0	Gurney W. S. ...	1	1	0
Byers J. ...		10	0	Halls H. H. ...	1	0	0
Byne Lt.-Col. R. M.	1	1	0	Hannaford G. ...	2	2	0
Candler Charles ...		10	6	Harding J. R. ...		5	0
Capron J. T. ...	1	1	0	Harker W. ...	1	1	0
Carr Mrs. ...		10	0	Harmer B. ...	1	1	0
Carruthers D. ...	2	2	0	Harvey Miss C. ...		5	0
Chadwick Dr. Morley	2	2	0	Haydon W. ...		5	0
Chamberlin Sir G. ...	1	0	0	Herbert E. G. ...	1	1	0
Chapman E. H., His Honour Judge ...	3	3	0	Heywood R. ...	1	1	0
Christie J. A., M.P. ...	1	0	0	Hili T. A. M. ...	1	1	0
Cleminson H. M. ...	1	0	0	Horsfall R. E. ...		10	0
Coates John ...		10	0	Howard C. B. ...		10	6
Coe Mrs. A. E. ...		10	0	Howlett Dr. J. K. ...		11	0
Collins W. G. ...		5	0	Hudson Lt.-Col. P., C.M.G., D.S.O. ...	1	0	0
Colman Miss E. ...	1	1	0	Jago C. ...		10	0
Colman Miss H. C. ...	1	1	0	Jessop A. L. ...	2	2	0
Colman R. J. ...	1	1	0	Johnson Miss A. M. ...		2	6
Colomb Admiral P. H., C.B. ...	1	0	0	Jones Sir Laurence, Bart. ...	1	1	0
Cooke A., F.R.C.S. ...		10	0	Keith E. C. ...	1	0	0
Cozens-Hardy A. ...	1	1	0	Ketton-Cremer W. C.		10	0
Cresswell Mrs. George	1	1	0	Kinder Rev. E. H.	1	1	0
Cruickshank W. G. ...		11	0	Knight E. ...	1	0	0
Davey G. ...		10	0	Lang Gordon L. ...	2	2	0
Deacon G. E. ...		10	0	Lee-Elliott Rev. D. L.	1	1	0
Dew Mrs. ...		11	0	Lewis J. Spedan ...	2	2	0
Dewar T. F., C.B., D.Sc., M.D. ...		10	0	Lister S. R., M.D. ...		11	0
De Worms C. ...	1	1	0	Littlewood Miss ...		10	0
Doughty C. G. ...	1	1	0	Lloyd Capt. L. ...	1	0	0
Drury G. L. ...		10	6	Do., special donation	1	1	0
Duncannon T. J. G. ...	3	3	0	Long Miss ...		5	0
E. B. S. ...	1	1	0	Long F., the late ...		5	0
Edwards Francis ...		10	0	Long S. H., M.D. ...	2	2	0
Carried forward ...	£87	16	1	Carried forward	£136	16	1

	£	s.	d.		£	s.	d.
Brought forward ...	136	16	1	Brought forward ...	196	1	7
Lucas Dr. G. ...	1	0	0	Sargent C. G. ...	1	1	0
Mack H. P. ...	1	1	0	Savill Harry ...	2	2	0
Macpherson A. H. ...	1	1	0	Savin A. C. ...	5	0	
McKenna Mrs. R. ...	1	1	0	Savory Mrs. ...	10	0	
McKenzie Miss G. ...	10	0		Scott Head Collecting Box ...	2	5	2
Meade-Waldo E. G. B.	1	1	0	Scroope H. W. ...	10	0	
Meadows Mrs. A. H. ...	10	0		Sewell P. E. ...	2	2	0
Mennell E. ...	10	0		Sheldon W. G. ...	10	6	
Micholls Mrs. ...	1	1	0	Simpson F. T. ...	2	2	0
Millard Miss I. M. ...	5	0		Smith Col. H. F. ...	1	1	0
Miller O. T. ...	5	0		Smith W. ...	1	1	0
Milne Mrs. Findlay ...	10	6		Soman A. E. & Co. ...	1	1	0
Mitchell Arthur ...	1	1	0	Spalding G. ...	10	0	
Moxey J. E. ...	1	0	0	Steward Rev. Canon ...	1	1	0
Murton Mrs. ...	1	0	0	Stewart G. B. ...	2	2	0
Nash J. E. ...	10	0		Stimpson E. ...	10	0	
Nash W. ...	1	0	0	Strachan C. E. ...	1	1	0
National Trust, The ...	10	0	0	Sumpter Dr. B. G. ...	2	2	0
Newman Miss F. B. ...	10	0		Tait W. C. ...	1	0	0
Oliver Prof. F. W., F.R.S. ...	1	1	0	Tancock Canon O. W.	5	0	
Oswald Nigel ...	8	18	6	Taylor Dr. Mark ...	1	0	0
Pain P. ...	1	1	0	Thompson W. H. ...	1	0	0
Patteson Mrs. F. E.	10	0		Thomson C. R. White	10	0	
Pearson S. V., M.D.	10	0		Thorpe W. H. ...	1	1	0
Penrose F., M.D. ...	1	1	0	Thouless H. J. ...	10	0	
Plowright Dr. C. T. ...	2	2	0	Tuke Anthony W. ...	1	1	0
Poole Miss D. Lane ...	5	6		Upcher H. E. S. ...	1	0	0
Powell A. M. ...	2	6		Upcher Miss L. ...	2	2	0
Preston Sir E., Bart., D.S.O. ...	1	1	0	Vesey W. Trevor ...	1	0	0
Purdy T. W. ...	1	1	0	Vincent T. ...	2	6	
Raikes Miss D. T. ...	5	0		Walter C. H. ...	1	1	0
Ransome Mrs. ...	1	1	0	Walter J. H. F., the late	1	1	0
Reeves H. ...	1	1	0	Watson-Kennedy Mrs.	1	1	0
Richmond H. W., F.R.S. ...	5	2	0	Wells C. H. ...	1	1	0
Riley W. ...	1	1	0	Willet W. L. ...	5	0	
Ringrose B. ...	1	1	0	Wilson Mrs. ...	1	1	0
Riviere B. B., F.R.C.S.	2	2	0	Winch Major S. B. ...	2	2	0
Robertson W. K. ...	10	6		Wormald Hugh ...	1	1	0
Rogers Rev. H. ...	1	0	0	Wright Dr. B. D. Z. ...	10	0	
Rose L. ...	1	0	0	Wright T. J. ...	10	6	
Routledge V. ...	10	0		Wyllys H. J. M., F.R.C.S. ...	10	0	
Royal Society for the Protection of Birds	2	2	0	Wyllys W. E. ...	10	0	
Ruggles-Brise Mrs. R.	1	0	0	Yeo Henry ...	10	6	
Carried forward	£196	1	7	Yeo Mrs. ...	10	6	
				Total ...	£240	4	3

GADWALL

A Duck Gadwall was shot on January 7th, 1924. It would appear that this is the first time, at any rate for several years, that Gadwall have been observed on this part of the River Wensum. They were evidently brought in by the severe weather which lasted from January 1st—14th, together with quantities of Mallard, Teal, a few Tufted Duck, Pochard, and Goldeneye.

There is no direct evidence in the shape of a nest that these duck have bred here, but the occurrence of a pair on May 6th, 1925, and two lots of two drakes on April 18th and 23rd, 1926, show that it is quite possible that they may have done so. Gadwall have not, I believe, been observed above Lenwade and below Elsing Mills. They have increased considerably since first observed.

WOOD LARK

Wood Larks' nests have been found north of Norwich during the past three or four breeding seasons. A pair with young were seen in the parish of Taverham in May, 1926. A cock was heard singing in the same vicinity on February 16th. A nest was found in March and another in May, 1927.

REDSTART

The first Redstart's nest in this neighbourhood for many years, probably between thirty and forty, was found on May 17th, 1927; this was unfortunately disturbed by boys, but the old birds built a second nest in the same hole and hatched off five young which flew on or about June 30th.

The parent birds had been observed in previous springs. One in 1924, a cock bird in May, 1925, another cock in 1926.

OBSERVATIONS OF INTEREST, OCTOBER, 1926—OCTOBER, 1927

Norfolk Plover heard for last time for the year on October 13th, 1926.

A late House Martin was seen on October 20th.

A Golden Plover was heard on November 22nd, the first for several years just here.

The first Brambling appeared on November 6th; a big influx of these birds took place this Autumn. As many as two

hundred in a flock were seen feeding in company with a few Chaffinches under the beech trees. They remained till the first week in March.

A flock of a dozen Crossbills was seen on January 1st. They remained round the house till the 10th.

A large flock of Lesser Redpolls was feeding on the alders on February 12th.

A Ringed Plover put in an appearance in May and was seen on a gravelly beach on the river on the 2nd, 4th, 5th, and 13th.

A neighbour caught a Hawfinch in a net over their raspberry canes on July 4th, the first seen here for several years.

Little Grebe returned suddenly in numbers on the river on October 3rd. While fighting on October 5th I heard a snipe "drumming"; is this not rather late?

During the summer two Cuckoo's eggs were found in empty nests, the first with Grey Wagtails already referred to, the second in a Wren's inside my workshop. Some people still insist that the Cuckoo never places its eggs in other birds' nests with its bill.

The nests of forty-five different kinds of birds were found here this breeding season.

One hundred and nineteen different species of birds have been recorded within a one and a half miles radius of Taverham since the War.

XI

CLEY-NEXT-THE-SEA AND ITS MARSHES

BY BASIL COZENS-HARDY

As the Norfolk Naturalists Trust is now a considerable land-owner in the parish of Cley-next-the-Sea, Norfolk, it has been suggested that some observations on the history of the locality may be of interest to Norfolk naturalists. In the remarks that follow I shall avoid ecclesiastical matters, and confine myself chiefly to the topographical and commercial history of the town and the immediate neighbourhood.

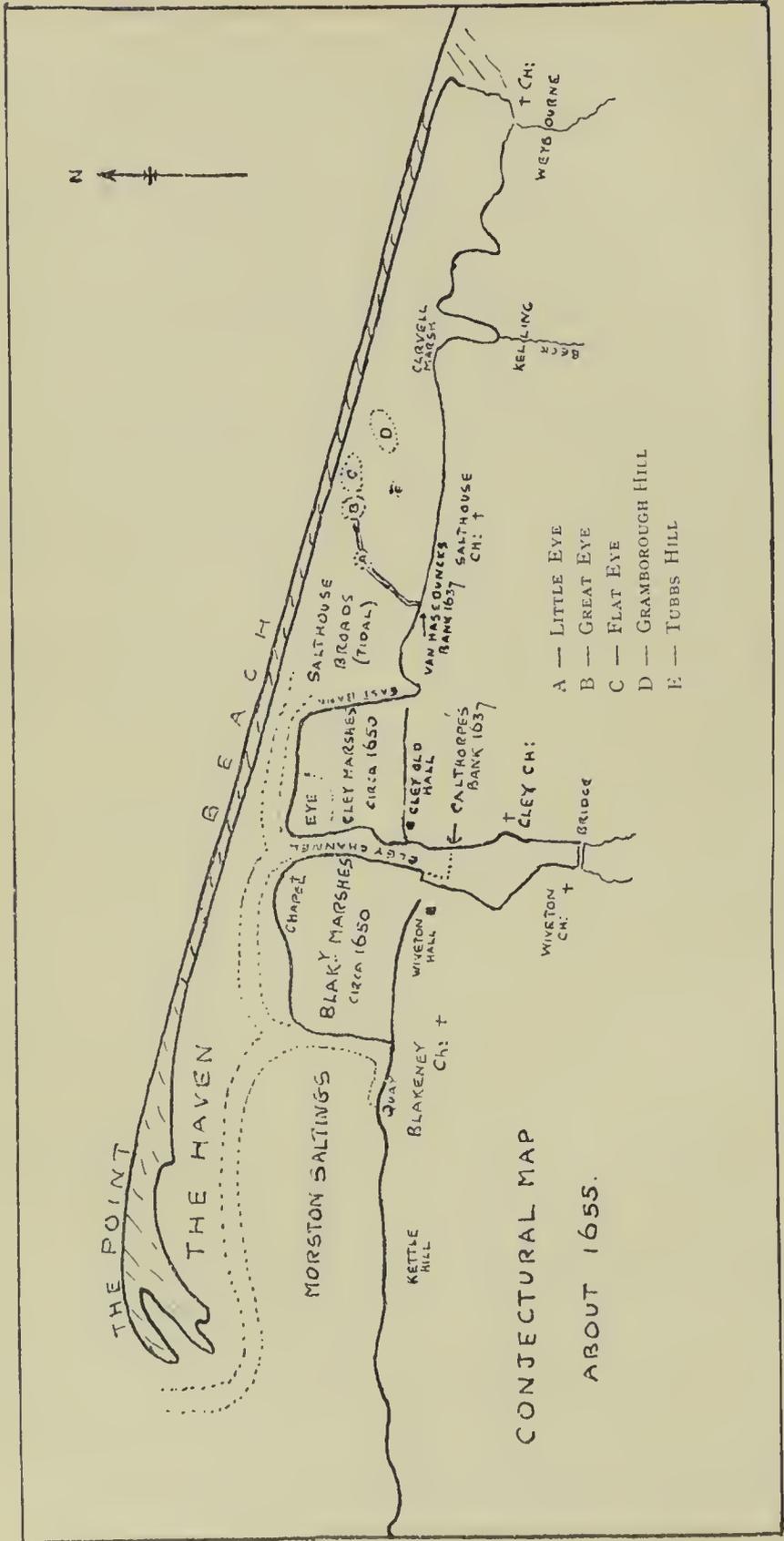
The origin of the place-name is in doubt. Those qualified to suggest are of the view that the name represents O.E. clæg "clay" and was so called from the clayey character of the soil, either in the marshlands or in the chalky marl of the upland sub-soil.

Cley owes its existence to the River Glaven, a short and, for Norfolk, a fast running stream of 12 miles length, rising east of Holt, at Bodham, and passing through five water mills in its course. If its waters had not had to find an outlet, there would have been no Cley or Blakeney harbour or anything in the nature of a haven or anchorage lying south of Blakeney Point.

That this neighbourhood has been populated since the earliest times is evidenced by the large group of barrows existing on the uplands of Cley and Salthouse and on Kelling Heath. Exploration of these barrows, has indicated a resident population about 2000 B.C.

Cley marshes as they are to-day were non-existent till the middle of the XVIIth Century. They were merely tidal muds like the saltings north of Morston, growing the typical seamarsh vegetation on the less frequently inundated parts and intersected by numerous meandering creeks.

It is interesting to speculate about the appearance in the Middle Ages of the reach of marshes from Blakeney to Kelling; much depends upon the extent of the Point. I have no knowledge of tides, currents, or sandbanks, but I have always the impression that the cliffs of vanished Shipden, off Cromer, are deposited on the shore extending from Kelling westwards to Brancaster and that, as far as Cley was concerned, there has always been a battle proceeding between the river Glaven endeavouring to force itself by the most direct route to the sea, and the currents driving backwards and westwards the beach and sandhills. The same battle, but in a minor degree, existed at Weybourne in the case of the small stream which drove the Prior's waterwheel there, and of Kelling Beck. It is worth while noting that the Weybourne stream, which used up to a few years ago to find an outlet round the uplands into the Kelling and Salthouse marshes and thence into Cley channel, has had its ancient right of way recently obstructed by the encroaching shingle and it has now to reach the sea by percolation through Weybourne beach at low tide.



To return to the question of the mediæval aspect of Cley sea frontage, there is some, but not strong, evidence that the Glaven flowed out at Cley near where it now takes the right-angled turn to the west. This would have insulated Blakeney Point. It is so shown in the Morden's map of 1698 (see photograph), but maps in those days were very unreliable in detail and two older maps discountenance this view. Moreover, if the river had not run out through the haven round the Point, the scour of the outflowing tide would have been greatly reduced, and the haven would have tended to silt up. I think, therefore, that it is improbable that the Blakeney Point was ever an island like Scolt Head.

Up to 1823 the sea flowed at every tide as far as Glandford. This accounts for three things: the tall arched stone bridge at Wiveton, the stone walls at the bottom of the upland from Town Yard in Cley, past the Green (near the Church), and as far as the Wiveton Bridge Road, and the somewhat straggling nature of both Wiveton and Cley. The houses were built along each side of the old estuary to get channel frontage.

Seawards the view would be very different from what it is at present. At a high spring tide probably the whole area now occupied by the Blakeney, Cley, and Salthouse marshes would be inundated. But besides the sea- and wind-made Point there would be standing out some pronounced islands, the product of glacial deposit rather than of gradual sea action. First there would be Thornham's Eye, now the N.E. corner of Blakeney Golf Links near the curving relief channel cut in 1924. On this Eye there was a Chapel, the foundations of which still exist. It was no doubt built and staffed by the Blakeney Carmelite Friars. It is said that there was always a Friar in attendance to bless passing boats, and that outside the chapel was an iron box fastened in the wall into which the fishermen dropped their thank offerings for a successful voyage.

By the kindness of Mr. Frank Monement, of Cley, I am able to reproduce a photograph of a map of the Haven in his possession, dated 1586. It shows, amongst other things, the Chapel and Friary, people gathering cockles, two men apparently fighting across a ditch, and two bridges at Wiveton,

A little further east, on the other side of the Cley Channel, we come to what was a large island, still known as "the Eye,"

and forming part of the property of the Norfolk Naturalists Trust. It was once a lay fee belonging to the Priory of Castleacre. The large Ordnance Map shows the site of a Chapel on it, but I think this is a mistake and such foundations as there are belong to a barn for agricultural purposes, as the Eye has no doubt been arable or pasture land since time immemorial. A description of the Eye in a deed of 1651 is as follows :—

“All that piece of high marsh ground in Cley aforesaid called or known by the name or names of ffoulnesse or East Eye conteyning by estimacon three score and ten acres with one lodge or house thereupon built lying betwixt ye marsh hereinafter mentioned on ye part of ye South and ye creeke comonly called Salthouse Channell on ye part of ye North and abutting upon ye creek called Cley Channell towards the West.”

This Eye was probably approached by water down the Channel or by the Driftway which still runs through the centre of Cley marshes to the east corner of the Eye. It would be difficult to make a road close to this channel, which would be the most direct route, owing to the number of wide creeks which ran into it. This driftway is described in the deed just mentioned thus :—

“Several posts and stulps set in a right line from a certain place five roods or perches eastwards from ye north end of a common way leading out of ye said North field of Cley called Procession Way Northwards to the most Easterly corner of ye marsh called ffoulnesse or East Eye.” Stulps were guide posts beside a causeway. The marsh adjoining these is still called “Great Stulps.”

The next island was, I suspect, situated somewhere near the north end of the present East Bank. At least, a map of 1649 of the Salthouse Marsh enclosure (see photograph) indicates some higher land at this point, called Rough Brough Hill, now long since beneath the sea. Further east, in front of Salthouse, there were four prominent islands: the Little Eye, the Flat Eye, the Great Eye, on which now is built that strange looking building called “Randall’s Folly,” (the Rocket House) and Gramborough Hill. Roman pottery has been found on the last, as well as at several points along the coast road.

If therefore one stood, say, in 1400, on a point on the uplands,



STIFFKEY

MORSTON

BLAKENEY

MAP OF BLAKENEY & CLEY HAVEN, DATED 1586

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one would have seen the whole expanse of land from Blakeney Point to Weybourne a huge salt marsh flooded at high tide. Here and there would be Eyes jutting out, some of them under cultivation. A broad navigable channel would run past Cley Quay and Cley Church up to and under Wiveton Bridge and possibly as far as Glandford. Another would run eastwards north of Cley Eye and of the area now forming the Cley marshes up to Salthouse and beyond to Kelling. At the present time, when in dry weather Salthouse marshes are only half flooded, the course of this navigable channel is still quite visible to anyone standing on Salthouse Heath above the church, and its course accords exactly with that shown on the map of 1649, here reproduced by the courtesy of Mr. Frank Monement.

The first part of the XVIIth Century was the great period of embankment. Between 1621 and 1656 the vast area of the Fens was reclaimed, in spite of much discouragement and opposition, by the directing skill of Sir Corneluis Vermuyden, the Dutch Engineer. When exactly reclamation began in the Cley district is not certain, but it seems in about 1637 operations of this kind commenced at Salthouse under the supervision of another Dutchman, named Van Hasedunck.

In 1638 there were some legal proceedings and an inquiry about "a new embankment lately made by John Van Hasedunck." Lady Sydney was the owner of "Greneburgh Hill" and of the Great and Little Eyes and the Flat Eye mentioned above. The allegation was, "the said new embankment made over the mayne channel between the great and little eyes" so "stopped and penned up the fresh water flowing from Waborne Mill and Kelling becke that the said Ladie cannot feed her grounds lying on the North side of the mayne channel which always have been known to be the right of the town of Salthouse." The inhabitants are excluded from "their fishing in the said channel and cricks" and from the sea "their chief means of livelihood" and "are forced to beg and seek new habitations." So ran the still extant depositions. The outcome of the law suit is unknown, though I imagine it was successful from what occurred twelve years later. Water rights and obligations have ever been a fertile source of dispute. The offending bank is shown on the map of 1649 and is there described as the "Old Bank," which seems to imply

that it was superseded in 1649, when the new and more extensive reclamation scheme was carried out as delineated on this map. It shows also the whole of the Salthouse marshes as far as the eastern boundary of the Trust's property, namely, the East Bank, which, however, had not then been completed, otherwise it would have been shown on the left edge of the map. The present beach line runs from the word "Salthouse" in "Salthouse Mayne Channel" to the north end of "Green Barrough Hill." This means that in about 275 years the sea has encroached by as many yards. Randalls Folly, already referred to, is on the Great Eye, and the present beach road runs through Tubbs Hill. When the 1649 embankments were made, as indicated on the west side of the map, the Salthouse main channel, then as wide as the Thames at London Bridge, became and remained for two hundred years an area flooded at each tide and acquired the name, which the locality still retains, of "Salthouse Broads." Just above and below the word "West" in "West Marish," are two interesting place names, "Dogger Layer Point" where they laid up their boats called "Doggers" (cf. The Dogger Bank), and "Little Harnser Marish," frequented then, as now, by herons.

About the same time Sir Henry Calthorpe of Cockthorpe, and, on his death his son Philip Calthorpe, began embanking their saltings at Blakeney and Wiveton, very possibly under the supervision of Van Hasedunck. Whether they first embanked the whole of the Blakeney marshes is (at present) uncertain. At any rate, they threw a bank across the river Glaven somewhere near the present one abutting the Cley-Blakeney road (see photograph). This did not prevent access of ships to the main Cley quays, but it obstructed water-passage up the Glaven valley to the south part of Cley near the Church and to Wiveton village. There was immediately consternation amongst the merchants and natives of these two townships, who saw ruin to their trade staring them in the face. The demolition of this offending sea-wall had to be secured at all costs. Their first move against what to us, knowing only one side of the question, seems a somewhat high-handed obstruction of a public and very valuable right-of-way was to induce the Vice-Admiral for this part of the coast to summon an "Admirall Court," which he did at Cley on the



Map, dated 1649, of Salthouse Marshes, showing Van Haseduncks Bank (1637)
in the left centre and later Embankments (1649) on the left

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31st January, 1638. Here is an extract (anglicised) from the record :—

“ Thomas Coe foreman of Jury.”

“ Present that the channel existing from time immemorial with a free passage by water from Cley to Wiveton where coal ships and boats have had passage is now debarred and stopped up by a bank now lately made by Sir Henry Calthorpe—now Mr. Phillip Calthorpe.”

The next move was to invoke the assistance of a local court of limited jurisdiction. There was a Department of the Manor of Cley-juxta-mare, which corresponded with what would now be called a Port and Haven Commission. They met as occasion required, and their proceedings are recorded in the Court Books of the Manor. Here is an extract translated from Latin into English :—

“ Cley Port. Port of Cleye Blakeney and Wyveton.

A General Court there held the 11th day of December
1638 (13 Car.l)

Jury Thomas Clowdislie* Gentleman
(and 20 others)

Who say upon their oath that Philip Calthorpe Esquire has made an obstruction with a great bank to the main channel between Cleye and Wyveton within the liberty of this Court of the Port along which channel ships since time immemorial have been wont without hindrance to sail from the town of Wyveton to the sea and from the sea to the Town of Wyveton and to load and unload their goods and chattels, and also another navigable channel† in Cley within the jurisdiction of this Court called Howgate Crick to the great injury and prejudice of the inhabitants of the towns of Cley and Wyveton and navigation there.”

Here follow records of a few minor offences which may be given in parenthesis to show with what matters this small court dealt :—

“ Thomas Welch removed certain pieces of wood from the channel to the damage of the banks—fined 3d., to replace stakes within 10 days.

* Grandfather of Admiral Sir Cloudsley Shovell.

† In those days the Channel divided into two by Cley Quay and did not join again till somewhere near the church.

Richard Woollver threw his anchor in the channel as far as a piece of floating wood called 'a boye,' which he ought not to do—fined 3d.

William Girdleston threw his anchor into midstream which he ought not to do—fined 3d."

Armed with the verdict of the juries of the Admiral Court and the Port Court, the inhabitants of Cley and Wiveton laid their grievance before the King by means of a Petition, which with the depositions is still preserved at the Public Record Office. It is of sufficient interest to be published at almost full length.

"To the Rt. Hoble the Lords of his Maies Noble Privie Councell presen these sent by

J Palgrave
Tho Windham
Phill Colby.

1. The antiquities of the haven appeareth by the Statute made the 31 Edw. 3.

2. That the same haven is sufficient to harbour shipp trading along the coast for safetie off life and goods in extreamitie appeareth for Thomas Saxsames *alias* a Dane on 10th April, 1638 being laden with 44 horses fit for His Majesties service and being ready to perish he with company shipp and goods was preserved, the shipp called the Jonas of Houson whereof fredrick Declesse was master all which had perished had they not in this haven been preserved for they were bound Eastwards and there is noe haven nearer then Yarmouth eastward which is about 30 miles distant.

3 That the same haven have had many good shipp of burthen belonging to it which have been set forth from thence to Westmonie and Island and to trade with Holland fflanders ffrance and Spaine and other smaller vessells carrying corne and other comodities to Newcastle etc, and bringing in coales salt and other merchandise for the countrie hereabout and likewise to the advantage of His Majesties customs and composition fish. That the 'Susan' of Wiveton was pressed in Queen Elizabeth's service in 1589 for service into Portugal of which Thomas Coe of Claye went as Quartermaster (as he doth testife). Thomas Coe affirmeth that they have 19 other good shipp, some of 140 and one of 160 tons belonging to the same towne (six being built at Wiveton near unto the main channel beside many others belonging to Cleye) by means of which his late Majtie King James of blessed memorie did receive for customs in one year £420 and now his Majtie (Charles) only £100.

Notwithstanding one Sir Henry Calthorpe decd, Mr. Phillip Calthorpe and workmen have erected one wall or banke of earth over two navigable channells the one in Cley the other parting the towns of Wiveton and Cley which taketh away the passage of shipp

and small vessels from the town of Wiveton wholly and partlie from the town of Clay and also doth out of the indraught of water 80 rodde and upwards in breadth and one myle at least in length south of the wall or bank aforesaid so that what silt or mudd the flood tide bringeth in doth settle and remaine in the common navigable channell lying along the keies of Cley through want of the ebbtide which formerly overflowed the aforesaid 80 rodde of ground in breadth and 1 myle in length. That the maine channell north of the said Bank is already groune up and landed 2 foote at the least as appeareth upon view to your worships. That the banke doth annoy the channell of Clay and stop the passage to Wiveton as was testified at the Admirall Courts holden at Clay on 31st Jan 1637 and 22nd Oct 1638 by 46 men (12 of Blakeney 6 of Wiveton and 8 more maisters-to-sea and many of them tenants of Sir Henry Calthorpe—also as testified by 21 men at a general Porte Court of Cley and Wiveton holden at Clay on 11th Dec 1638. Which said banke if it be not timely taken away and the grievance prevented will utterly destroye the haven to the great prejudice of his Matie and his customes and composition fish, the destruction of navigation in the porte and the utter ruine of trade and tradesmen of Clay and Wiveton and great prejudice of the Country adjacent ”

The Petitioners then estimate the damage by a comparison of the trade in 1637 (the same year the banke was made) with 1638 :—

1637—1053 chaldron of coales (Newcastle measure) imported

—614 lasts of corne carried out

1638—538 chaldron of coales

—226 lasts of corne carried out

1637—349 weights of salt imported

1638—324 do.

From this it is calculated that the reduction of portorage was £36 10s. 6d.—‘ the amount the poore porters lost ’ and if the poore lost soe much it may be considered what the merchants maisters and mariners and the rest of the inhabitants were damnified.

That the country for want of coales etc were enforced to give farr greater prices than they formerly had done or to seek to further places to their great damage.

That one master of a shipp cannot hire his company this year because the men though the same as last year claim greater wages because their labour has been augmented by lightering up their coals they brought home, and he has been forced to go elsewhere for a crew.

That whereas in 1637 30 entries of ships are recorded in the customs house records only 14 made entry in 1638.

Additional note of evidence submitted by Wiveton witnesses signed by each.

ROBERT HILL testified that “ before the maine channell was stopped by the banke my coale and other comodities were brought up neare my gate and bearers did carry them in to my house at 4d or 6d per chaldron without carting them, that the poor have now

to go to Cley or Blakeney for coals and to buy them by the bushell and for need thereof they have broken down many hedges notwithstanding the mildness of last winter "

MARY RINGALL testified that a boate with some 30 chaldron of coales came up in a lighter for her expense and her neighbour Goodman Williams before the banke was erected and then she bought these for 12/8 per chaldron, but now for 17/6 " and the banke hath almost impoverished " her for she " was wont to make 7 or 8 bedds on one night " and now she makes " but one in one night for strangers."

ELIZABETH EGMERE says that she sent " her biskets by boats bringing in coals by a main creek issuing out of the said channell and has now no way of carrying them."

I suspect Mary Ringall kept a lodging house. The necessity of having to provide half a dozen beds nightly for seafaring visitors to Wiveton is a good indication of the thriving maritime trade of those days.

The result of this Petition apparently was that the bank was demolished and the tide flowed once again past Cley " Key " to and beyond Wiveton Bridge. It is possible that, thus thwarted from his purpose to embank the sea out of the Glaven Valley by a short bank between Cley and North Wiveton, Philip Calthorpe proceeded to erect the long semi-circular sea-wall now enclosing the Blakeney Marshes and Golf Course. The actual date must remain in doubt until the Calthorpe Papers now in Hampshire have been inspected.

The date on which the Cley Marshes were embanked remained uncertain until quite recently. Col. E. A. Bulwer, of Heydon, found among his papers and gave to me a deed already referred to, which was the marriage settlement between Symon Britiffe, son and heir-apparent of Edmund Britiffe of Baconsthorpe, and Hester Harbord the daughter of Sir Charles Harbord of The Moore in Herts. It is dated the 11th March, 1651, and by it Edmund Britiffe, the Lord of the Manor and chief land-owner in Cley, settled upon himself and his bride the Cley Estate including the greater part of Cley Marshes, which are described in some detail. In this description the marsh is referred to as " ye *late* embanked marsh of ye said Symon Britiffe." We may assume, therefore, that these marshes were drained and enclosed by Simon Britiffe about 1650. It is not unlikely that Van Hasdunck and his men first embanked Salt-house and Kelling Marshes, and then directed their attention to

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Morden's Map (1698) showing Blakeney (A) and Cley (B) Marshes embanked



Cley from Blakeney Hill, showing the 1823 Bank which is the probable site of the Calthorpe Bank of 1637

Blakeney and last to Cley. He seems, however, to have been a prominent Royalist. He was in Elizabeth Castle in the Isle of Jersey at its surrender to the Roundheads, and his property was sequestrated. It consisted only of twenty-two acres at Thornham East, in Norfolk, which may have come to him as pay for some embanking operations there. In 1646 he apparently compounded with a fine and regained his property. His Royalist proclivities may have made him unpopular in a district predominantly Parliamentary, and they may have jeopardised his retainer as drainage expert at Cley.

To anyone planning the embanking of the Cley Salt Marshes the Eye would seem an obvious pivot, as not only is it at the north-west extremity but its natural elevation would obviate a bank to the extent of its breadth. So it was. Britiffe erected his bank from his "capital messuage late ye said Robert Beales," now the Old Hall, and thence northwards abreast the Cley Channel to the west side of the Eye and thence from the east corner of the Eye along the Salthouse Channel to some higher land at the N.E. corner and thence by the straight and existing East Bank back to the uplands. I suspect that the present reed beds, the haunt of duck and snipe, mark the site of the old creeks, which intersected the marshes in their tidal days. This embanking did not interfere with the navigable Salthouse Main Channel, which at that time ran north of the marshes towards Salthouse, and there is no evidence that Britiffe experienced the same kind of opposition as was offered to the Salthouse embankment and the Calthorpe enterprise. He was merely enclosing his own property, and in so doing obstructed no one's right of way.

For about two hundred years Cley marshes remained unaltered, providing excellent pasturage for local flocks and herds and possibly wild-fowling. The sea was, however, encroaching, and the beach was being pushed back on the north at the pace estimated at about one yard a year, and by 1850 the channel to Salthouse was to all intents and purposes blocked with shingle preventing the outflow of fresh water from the Salthouse and Kelling marshes. The late Mr. C. J. Temple-Lynes, of Blakeney, who died in 1926, aged 83, used to say he remembered as a boy sailing from Cley channel into

Salthouse Broads at the N.W. corner of Salthouse marshes. This blockage caused the Salthouse marshes to become water-logged, and in 1855 a new embankment scheme for Salthouse and Kelling marshes was carried through, whereby the sea wall (now much breached) was erected the whole way along the coast from Weybourne, and an outlet for the fresh water was found by driving the "main crick" through Cley marshes into Cley channel. In 1861 this new bank broke, and Salthouse marshes resumed periodically their previous sodden condition. This in recent years became much aggravated, because Cley channel itself silted up and the level of the channel bed had become too high to permit any appreciable outfall from the main creek through Cley marshes. In 1924 a new channel was cut on the Blakeney side near Blakeney chapel. This has helped considerably the drainage from the main creek at low tide.

Since the beach was driven up against Cley marshes, the danger point has always been at the end of the East Bank at the N.E. corner of the marshes. The storm of 1861 breached the Cley bank as well as the Salthouse sea-wall. The writer's father remembers a messenger arriving at Letheringsett Hall, where the then owner resided, bringing the unwelcome news that the bank had given way. In 1897 the sea broke through again at this spot (see photograph) and the bank was repaired at considerable cost and faced with concrete. This lasted until 1921, when once again the sea overcame the defences, and the owners of the Cley marshes have now retired from the unequal contest. The marshes are likely to become more brackish as time goes on and their water-logged condition makes the draining of the Salthouse marshes more difficult, as the owners of Cley marshes obviously cannot allow Salthouse water to pass, whilst their own marshes are flooded.

The history of Cley embankment would be incomplete if one omitted to mention that where the Calthorpe bank was demolished in 1639 a new bank was constructed under an Inclosure Act in 1823 and the new road between Cley and Blakeney constructed. Hitherto Blakeney was only approached from Cley by Wiveton bridge, though there was some sort of causeway (they probably called it a "carnser") and bridge near the present road, but this can only have been available

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The Breach in the Cley Sea Wall in 1897



View (before 1823) from the old 'George' Quay at Cley showing the Wooden Bridge, Blakeney Church and Wiveton Hall

at low tide. The effect of the bank has been still further to land up the channel by Cley quay, as the scour of the ebb and flow of the tide has naturally been reduced. The more one embanks an estuary the more does what is left become silted up. Only once, I believe, has this bank broken and that was in the 1897 storm above referred to, when the Wiveton Valley became for a few hours a rough sea.

THE WOODEN BRIDGE AND GREAT TIDES.

The following notes, with the exception of two paragraphs, are taken from some memoranda made in the Cley Parish Register by the Rev. Robert Thomlinson, Rector 1764 to 1801. The wooden bridge was situated very near the present Cley-Blakeney road. An illustration of it is given in this paper. The causeway leading to it may very likely have been what was left of the Calthorpe bank of 1638.

In 1739 a wooden bridge was thrown across the salt marshes to Wiveton which cost 60 or 70 pounds. Patrick Eson, collector of ye Customs, was the undertaker and took great pains in procuring subscriptions for ye same.

17th October 1798 At the Quarter Sessions at Holt the wooden bridge leading from Cley to Wiveton and Blakeney was presented by Mr. Robert Brereton (foreman of the Jury) as being dangerous and ruinous.

24th July 1799 Philip Roome deposed that he remembered the bridge being built by subscription in 1739—kept privately up—never a public right of way.

The Court was satisfied that neither Cley nor Wiveton was obliged to keep the bridge in repair.

HIGH TIDES.

On Sunday night the 15th of Feb. 1735/6, a violent storm arose at North West and continued till Tuesday morning and the Spring tide happening at the same time brought the sea in a most terrible manner upon the Shoar ; so that it overflowed the great Beach at Clay and almost demolished the Town, many of the inhabitants of which were obliged to run up to their upper rooms to prevent their being drowned and were afterwards taken out of their windows by Boats. The marshes thereabouts were overflow'd and nine feet water left in them ; and the whole coast from Cley almost to Lynn was overflowed by which great Damage has been done.

The first high tide I remember was in 1767 ; the banks of both Cley and Blakeney were broken down ; all the fences of the Enclosures next the road leading from Cley to Salthouse were washed down, by which John Thomlinson suffered at least £500. At that time he allowed his tenants £40 damages.

On Jan. 1, 1779 a violent gale of wind with prodigious large Tide drowned the marshes of Cley and Blakeney and did damage to the town, getting into the Malthouses and spoiling corn in the granaries.

1780 Ditches were made to fence the marshes from the road.

30th Oct. 1789 12 o/c in night a sudden and violent gale of wind with a large tide. The tide forced a new ship, called the Abbicore, belonging to John Learner, Merchant, from her moorings & the ship went directly thro' the wooden bridge and half way up the Creek towards Wiveton stone bridge. She was obliged to be dug out & a great part of the Bridge taken down to let the vessel into the course of the Channel. A Subscription was immediately begun towards repairing the wooden Bridge leading from Cley to Wiveton. 50 guineas raised and the bridge put in excellent repair and bank gravelled.

2nd. Feb. 1791. A gale of wind, when Cley marshes were drowned owing to the East Bank being made lower after the Rage in 1779; the water was about 2-ft. on the level on Cley marshes—a hay stack stood in the marshes all the time. The water ran out of Salthouse Channel over Cley East Bank from 7 in the morning till 2 in the afternoon.

Notwithstanding these floods no abatement was ever asked or made in the payment of tythe.

R. Thomlinson, Rector.

An Account of extraordinary high tides, commonly called "Rages" in Cley and Blakeney :—

Nov. 25, 1665	Feb. 28, 1749
Oct. 8, 1690	Jan. 2, 1767
Feb. 16, 1735	Jan. 1, 1779
Feb. 7th, 1741	Feb. 2, 1791
Dec. 12, 1744	

There appear to be about 8 Rages in 100 years.

TRADE OF CLEY.

Before the advent of railways and while coastal trade was carried only by small sailing ships, the three towns of Blakeney, Cley, and Wiveton had always a considerable trade. Cley's trade decline in recent years has no doubt been accelerated by the silting up of the channel. Old inhabitants have told me that they remember seeing a long line of farm waggons filled with corn extending from the quay as far as Town Yard waiting to unload into ships lying at the quay. The photograph printed with this paper of a ship unloading near the windmill quay was, I am told, taken in the seventies.

Cley was probably at the acme of its prosperity in the XIVth Century, when its church was rebuilt. Norfolk produced

what the Low Countries wanted, and a coastal town with a good haven was bound to be busy with the exportation of wool. It must indeed have been the staple trade of the port, and it did not suffer decline until East Anglia began to acquire skill at weaving under the tuition of the Strangers. This tended to keep the raw wool at home for manufacture.

The earliest reference to the port and its trade is a verdict in 1285 of the Jury of the Cley and Blakeney *alias* Snitterly* Ports. They say on their oaths that the ports belong to lords of the manor and their liberties and right to wreck extend from Hancon-ketil† in Morston to Carwell‡ mill and the liberty of free warren extends from Benesherd|| to Roger Agges Gate in Salthouse. All ships that enter the port and buy or sell or dry their nets or spread them at the first coming, pay the lord 4d., and so every year 4d., except the ships belonging to the Cinque Ports, to London, Colchester, Rochester, "Maydenston" and Yarmouth, which are all free. Every herring cart pays 1d. a thousand carried out. Every ship belonging to Snitterly pays 60 custom herrings a year to the lord. All things both in the ships and out must be measured by the lord's measure. Every pack of wool brought in or carried out of the port pays 4d. No bailiff can enter the Liberty of the port to take distresses, except the lord's bailiff, neither can anyone within the liberty carry a mace or any ensign of authority without the leave of the lord or his bailiff. No coroner can enter to sit upon any one drowned or murdered. The lords constantly hold their Court from Tade to Tide.§

Many of the early records which survive relating to trade are connected with the compulsory purchase of supplies for the Army in France and the 'indent' on Cley was usually for salt fish. Salt for this purpose was no doubt imported, but it was made in small quantities in Cley. The hollow marsh at the S.W. corner of the Trust's property not far from the Windmill, is still called the Saltpan. In a deed of 1721 it is described as "ground formerly used for saltpanns

* Snitterly was the name of a village by Blakeney, now disappeared.

† There is a Kettle Hill in Morston.

‡ There is still a Carvel Marsh in Kelling.

|| This was in the Channel leading to Blakeney quay.

§ I have no explanation to offer about the meaning of this phrase.

or salt works." Being near the channel the water could easily be let in by a sluice as and when required. The following is an extract from the Register of the Black Prince:—

EXTRACT FROM REPORT OF BLACK PRINCE.

On May 20, 1351, there is an order to Thomas Storm of Blakeneye and to the bailiff of the Haven of Blakeneye reciting that whereas he needed :

" A great number of salt fish for the victuals of our household this next voyage across the sea for the war and our Sergeant Thomas de Sandewyc, acatour of our household, whom we have sent to Saint Botolf (Boston) to make purveyance of stokfissh for our use for the said voyage cannot quickly get to your parts to get the said fish We trust to you to get for us in the towns of Blakeneye, Snyterleye, Wyveton, Clay, Salthous, Shiryngam, Welles, Crowemere, and other neighbouring ports, both within and without the franchise, and to seize to our use to the number of 1200 lobbe being talcod and other kinds of salt fish and to have them kept until the arrival of the said sergeant."

Years later, in 1523, provisions were shipped from here by Cardinal Wolsey's Order to Calais for the army and navy. They included 'dried cod bought from Wm. Momfort of Cley at 45s. per 100.'

In Queen Elizabeth's time the exigencies of naval defence necessitated frequent naval musters. It is difficult to realise that the Royal Navy at the time of the Armada consisted of 28 sail, mostly small, and these were starved in munitions and supplies by the Queen's parsimonious policy. Reliance had to be placed upon merchants and their ships, never without some armament in view of the constant menace of pirates who abounded particularly on our East Coast. Amongst the Domestic State Papers of James I. there are two interesting letters of 1619 about pirates. Apparently an order had been issued to raise £200 locally for suppression of these pests. The Yarmouth Bailiffs beg relief, though willing to do what they can, but are heavily burdened with charges of piers and haven. Accompanying this letter is another from the inhabitants of Cley, who are the only people on the coast who "send their free contributions though very poor."

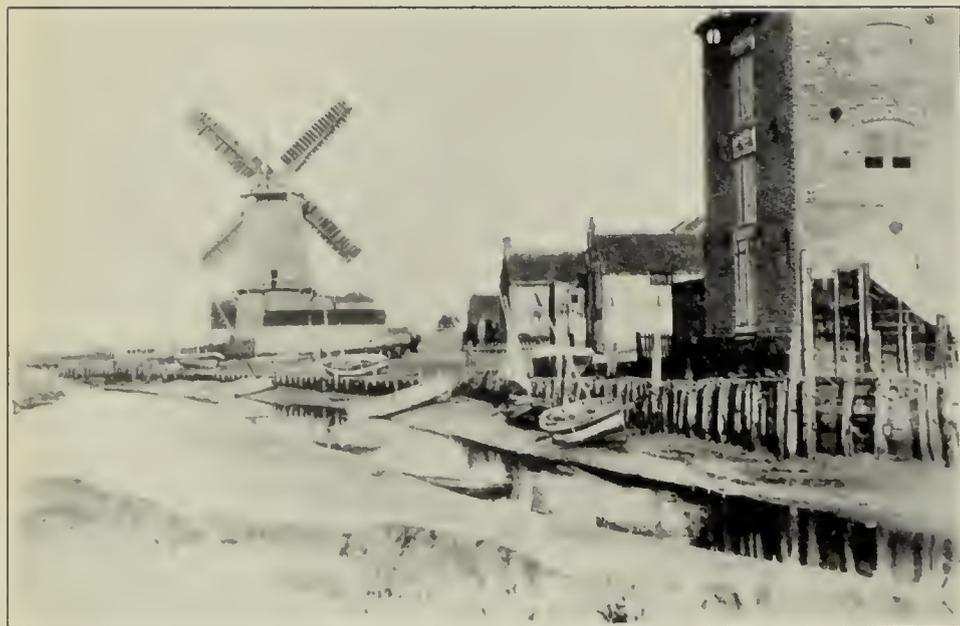
The following Muster Roll for 1570 is valuable as it gives some sort of comparison between the Norfolk Ports:—

" Names of mariners and all ships above 30 tons certified to the Rt. Honble. Lords of the Council by Sir Thomas

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Ship at Cley Quay near the Mill, about 1875



Cley Quay, about 1900

Woodhouse Knight and Henry Woodhouse Esquire Vice-Admiral there.”

The list can be summarised thus:—

				Ships.	Mariners.
Lynn	...	...	...	24	141
Holme	...	...	...	2	9
Welles	...	...	...	10	69
Blakeney	...	...	...	11	52
Wyveton	...	...	...	8	43
Clay	...	...	...	13	65
Salthouse	...	...	...	—	38
Kelling	...	...	...	—	5
Waborn	...	...	...	4	17

The Cley ships, given by name, consisted of 3 of 100 tons, one of 90, one of 80, and the rest smaller down to 30 tons. Small indeed they seem to us, but the Pelican, in which Sir Francis Drake sailed round the world in 1572, was a brigantine of only 120 tons. The Pilgrim Fathers' Mayflower was but 140 tons.

What is really surprising is the size of the ships belonging to this Haven in 1582 compared with those of the other larger Norfolk Ports:—

					Ships of 100 tons or over.
Cley	...	...	...	...	2
Wyveton	...	...	...	...	4
Blakeney	...	...	...	...	1
Lynn	...	...	...	...	2
Yarmouth	...	...	...	...	4
Welles	...	...	...	...	3

The trade which these merchantmen carried on when not engaged in fighting the King's enemies, regular and irregular, was chiefly, certainly in the middle ages, the export of wool and corn to the Low Countries, and the import of manufactured goods from the Continent. I have an original letter dated 1587 addressed by John Braddock, a merchant at Wiveton, to Sir Nathaniel Bacon of Stiffkey, stating that a ship had just arrived from Hamborow* with some Spanish salt and

* Hamburg.

pipes of oil and also "dry ffatte" and "babies and rattells for children with many other such trifles which come from Germany." Even in those days the Germans were apparently adept at making dolls. There was also a considerable trade with Iceland, or "Island" as they spelt it, in connection with, probably, the whale fishery.* They used to classify ships as "Island ships." With regard to local fishing, one of Blomefield's correspondents says in 1735 that "the Harbour is noted for fish called smouls, and that the fishermen have the liberty of fishing with a canvas net havjng a coat of mail at the end."

By the XVIIth Century, coastal trade appears to have become more important than foreign trade. The Petition of 1638 quoted above gives a good idea of its dimensions. Grain was sent north in large quantities. Indeed in 1631 Cley's export trade caused resentment in Norwich. The City Fathers complained officially to the Privy Council that the number and the misery of the poor of the City had so increased that the petitioners had been obliged to put upon themselves and the better rank of citizens treble as much as they formerly paid, and all citizens twice as much. They had borrowed £300 to disburse in corn for the poor, while exportation of corn was still carried on at Wells and Cley under a licence from the Privy Council, which they prayed might be recalled.

The ship that took corn to Newcastle brought back coal. Cley was probably the coal emporium for North Norfolk. It must be remembered that until the advent of railways practically all coal was sea-borne. It could come in no other way. That is why it used to be called "sea-coal" to distinguish it from the other form of coal—charcoal.

There was an interesting Memorial in 1728 from the Merchants of Cley to the Board of Customs protesting against the proposal to confine the lading and unlading of ships to a new and inconvenient 'Key.' In the course of this Memorial they give details of the staple trade, "from whence great quantities of Malt and all sorts of Corn and Grains and divers goods and merchandize have been from time to time exported and great quantities of Coals, Iron, Fir, and other Timber, Deal, Tiles, Stone, Salt, and other merchandize imported."

* There are whalebones used as posts outside the Manor House at Cley.

Now, alas! Cley's mercantile glory has vanished. The channel is 'landed up' and the quays deserted. The granaries have been converted into cottages or garages, or have been pulled down. The old Customs House is still there, a charming little house to testify to the town's erstwhile trade. But Cley still attracts the fowler, the naturalist, and the artist. May they combine to prevent its gradual vulgarisation by petrol pumps and stucco.

XII

ADDITIONS TO THE NATURAL HISTORY COLLECTIONS IN THE NORWICH CASTLE MUSEUM DURING 1926

BY F. LENEY, Curator

THE Collection of British Birds has been greatly enriched during the year under review through the generosity of the late Mr. Francis Allen and of Mr. B. B. Riviere. The birds in the Francis Allen Collection were all obtained on the Cockley Cley estate near Swaffham and are shown in their natural habitat in lightly constructed glass cases. The various groups are very effective and are remarkably good examples of Messrs. Rowland Ward's work in taxidermy. Special mention must be made of the cases of Teal, Mallard, Pochard, Golden Plover, Norfolk Plover and the Sparrow Hawks. One large case shows a group of the various species of Corvidæ, viz., Jackdaw, Rook, Hooded Crow, Carrion Crow and Magpie, an admirable piece of work of educational value.

Mr. B. B. Riviere's collection includes some of the rarer British birds taken in Norfolk, as for instance the Spoonbill, the Avocet, the Greenshank in winter plumage, the Shore Lark and the Little Gull. Mr. Riviere has also most generously presented his collection of British birds' eggs, as the exhibited series at the Museum had lost their colour. Clutches of eggs of nearly all the birds which breed in Norfolk are included in

the collection, together with a Catalogue giving the full data for each species, and it is the intention of the donor to add to his gift as opportunity occurs.

The Castle Museum Committee greatly regrets that it is impossible to exhibit the various collections of British birds which have been presented or bequeathed to the Museum during recent years, such as those from the Rev. Maurice Bird, Mr. Christopher Davies, Mr. W. J. O. Holmes, and Mr. Gerard Gurney. A Sub-Committee has been appointed to prepare a scheme for re-organising the arrangements for exhibiting the Bird Collections, and it is hoped in the near future that this section of the Museum will be brought into line with modern methods of classification and arrangement

Foreign birds include skins of the rare *Pteronetta Hartlaubi* from Egypt (sent with full data of size, place, etc.) ; mounted specimens of the Avocet and the Oyster Catcher from West Africa ; an Egyptian Goose taken in Norfolk ; a mounted specimen of the beautiful Lady Amherst's Pheasant ; also a male Rhea in full plumage which died in captivity at Keswick, and was mounted under Mr. Gerard Gurney's superintendence. Skins and eggs of both the Antarctic Penguin and the Gentoo Penguin were received from the Graham Land Expedition of 1920-22, and a small collection of bird skins from El Mansura, in Egypt. Difficulty has been experienced with H.M. Customs in the matter of birds sent direct to the Museum from abroad, and in some instances the specimens were held up for weeks in connection with the regulations of the Plumage Act.

The Mammalian Collection has received the addition of a Blackbellied Wallaby and a Marmoset, both of which died in captivity, and several small British Mammals. Through the kind offices of Mr. Robert Gurney, the Trustees of the British Museum presented a series of specimens of Crustacea and it is hoped to provide an instructive Index Collection to this little known group of Invertebrates.

Various publications relating to Natural History subjects have been received from the British Museum, the United States National Museum and the United States Bureau of Fisheries.

XIII

OBITUARY

FREDERICK LONG, M.R.C.S., L.R.C.P.

1840—1927

WE regret to have to record the death of Mr. Frederick Long, which took place on 23rd February, 1927. A member of this Society since 1881, he was elected President for 1903-4, and was made a Vice-President in 1923. His interest in botany commenced at an early period in his life, and he found plenty of material at Wells-next-the-Sea and the district, where he carried on his medical practice till 1899, when he retired and came to live in Norwich. However, on relinquishing his practice, he continued his botanical researches in Norwich and the neighbourhood, and other places, with possibly even greater assiduity. He visited Madeira and Zululand in 1916, and brought back collections of Grasses from both these regions. Mr. Long's most important discovery was that of *Sonchus arvensis* L. var. *angustifolius* Meyer, in 1822. This was an addition not only to the Norfolk list, but the first record for the British Flora. It was first found at Wells, and seems to be a maritime variety. It is mentioned in Mr. Long's first contribution to the Norfolk and Norwich Naturalists' Society's Transactions in February, 1887 (vol. IV. p. 371, "Rare Plants from Wells and neighbourhood"). Other additions to the Norfolk County list included the following:—*Poa subcoerulea* Smith, Wells, 1906; *Bromus erectus* Huds. var. *villosus* Bab. near Holkham; *Glyceria distans* Wahlb. var. *pulvinata* Fries. Wells. This grass was examined by Mr. Arthur Bennett, who gave his opinion upon it, and considered it the Scandinavian variety, so named. *Festuca rubra* L. var. *grandiflora* Hack. f. *littoralis*. This was a marsh grass growing at Wells, subsequently named by Prof. Häckel. *Trifolium pratense* L. var. *parviflorus* Bab. first found at Stiffkey, and recorded in our Transactions in 1887. *Cardamine pratensis* L. var. *palustris* Peterm, found at Arminghall in 1903. *Lavatera cretica* L. Sheringham, 1921.

In 1903 Mr. Long read an interesting paper on the result of his observations on "The Thick Adventitious Growth on the Boughs and Trunks of our Forest Trees." This thick growth of foliage he had noticed for several preceding years, and attributed it to the remarkable cold blast which swept over the country on 16th May, 1895. The gale blew from the N.N.W., and was accompanied by sleet and hail. The Oaks and Elms, which had just come into leaf were unable to resist the cold blast, and the leaves were all destroyed. Later on, a fresh crop of leaves appeared, accompanied by an abundance of adventitious shoots along the branches, giving them a fringed appearance. With reference to this storm, Mr. Preston, in his Meteorological Notes for 1895, remarks, "The young foliage on the north sides of trees was torn to shreds and blackened, and in many instances, never recovered throughout the summer." This paper shews Mr. Long's keen interest in the varied aspects of trees, of which he was very observant.

His paper on the "Protection of Plants" which was read to the Society in 1903, when the subject was much discussed, contained several good suggestions, being written in no fanatic spirit, and marked by strong common-sense.

During his residence in Norwich, he took great interest in the botanical collections in the Castle Museum. He compiled a M.S. catalogue of the Salmon Herbarium, bringing up the nomenclature to that of more recent times.

In the meantime, however, he was assiduous in keeping up, and adding to his own herbarium. Most of the specimens, nearly 2,000, were, if not absolutely collected by himself, certainly mounted by him. A certain number were sent to him by the Watson Botanical Exchange Club, of which he was a member, and the mounting of these, with a little help, occupied him almost to the day of his death. The collection is fairly representative of the Flora of the British Isles. It is a matter of congratulation to the Castle Museum, and to Norwich, that these collections were bequeathed to the Norwich Museum.

He was a regular attendant at the meetings of the Society, where his knowledge of botany was frequently called upon, and his genial and kindly manner much appreciated.

SIR DIGBY PIGOTT, C.B.

1840—1927

REGRET will be felt by many at the death of Sir Digby Pigott after a long career of usefulness in official life. First appointed to the War Office in 1859, he served as private secretary successively to Lord Northbrook, Lord Lansdowne, and Lord Cranbrook. In 1877 he was made Controller of the Stationery Office by Lord Beaconsfield. In 1888 he received the additional appointment of Printer, under letters patent, of all Acts of Parliament, and held in that capacity the copyright in all government publications. As Queen's Printer he was responsible for the production of the official Reports of the Challenger Expedition. These Reports consist of 50 volumes and were printed in 1880-1895. The supervision of them brought him into contact with many of the foremost scientific men of the time.

He received the honour of C.B. in 1890 and was knighted on his retirement in 1906. In Sheringham, where he resided after his retirement, he found a suitable locality for his ornithological and literary tastes. He joined our Society in 1892, and was also a member of the British Ornithologists' Union. He contributed occasionally to the Contemporary Review and to Blackwood's Magazine, and was the author of several books dealing chiefly with natural history. In 1883 he brought out a small book entitled "London Birds and London Insects." This was an amplification of articles previously published in various magazines. That portion of the book which deals with the insects of London consists not only of a fascinating view of a class of living organisms some noxious and some beautiful, but also really forms a very good introduction to the study of entomology. The book is enriched with many quotations from the classics and from modern writers. Other publications of his were "Tommy's Adventures in Natureland," and "The Changeling."

JOHN HENRY FRASER WALTER

1847—1927

By the death of Mr. Walter on July 16th, 1927, the Society loses a former President who had been a member since 1875.

Though his main interest was Archæology, he did not neglect natural history. In the course of his life he had travelled extensively, not only in Europe, but in the United States, Canada, Egypt, Algeria, and Morocco. In April, 1897, he read before the Society a short paper on "A visit to an Egyptian Ostrich Farm," and, for his Presidential Address in 1915, he chose for his subject the collection of birds' eggs formed by his father, Henry Fraser Walter. This address included an interesting account of the eggs of the Great Auk and other rarities. Mr. Walter always took a great interest in the Norwich Museum, on the Committee of which he served for 34 years. In 1921 he founded a society known as "The Friends of the Norwich Museum" with the object of enriching the collections by the purchase of objects which the limited funds of the Museum would not allow the Committee to obtain. A keen collector himself, with a rare knowledge of various branches of art, Mr. Walter was able to offer to the Museum, either as his personal gift, or as a gift from the "Friends," many most valuable treasures. He will be much missed in Norwich as a good public speaker, but not least for his kindly manner which never failed to attract.

R. J. HOWARD

1852—1927

WE have also to record with regret the death of Mr. R. J. Howard of Blackburn, a well known ornithologist and a member of our Society since 1887. He was a member of the British Ornithologists' Union, and was looked upon as a recognised authority on birds, not only in his district, but over a wider area. He took a keen interest in the Blackburn Museum, superintending the whole of its mammal and bird collections. He assisted in the production of Mitchell's "Birds of Lancashire" and "Birds of the Stonyhurst District." The 2nd edition of the former work was edited by Howard Saunders, who testified to Mr. Howard's valuable assistance in bringing it out. He was on terms of warm friendship with A. Thorburn who submitted most of the sketches for the "Book of British Birds" to Mr. Howard before publication.

To the Blackburn Public Library he rendered very useful services. His first association with it began in 1874. In 1915 he became Chairman, a position which he occupied till his death. He was made a vice-president of the Royal Lancashire Agricultural Society in 1915, in recognition of his valuable services to agriculture.

W. A. N.

XIV

MISCELLANEOUS NOTES AND OBSERVATIONS

THE LARGE COPPER BUTTERFLY—(*Chrysophanus rutilus*).—The attempt which was made last year to introduce the Large Copper Butterfly into some of the Norfolk marshes has unfortunately not met with the success which was hoped for. This is primarily due to the lack of sun and warmth, and to the large amount of wet, cold weather there has been during the past summer. As I stated in the account published in our Transactions for 1925-26, nearly 550 butterflies were liberated at Woodbastwick during July, 1926, and about six weeks later some 150 larvæ were counted, ready to go into hibernation for the winter. This season a very few full fed larvæ were noticed on May 24th, also pupæ. The first one hatched on June 27th, and the last on August 2nd, but hardly any imagines were seen, and no ova at all have been found; so that unless more pupæ are put down early next summer, it is obvious the species will have entirely disappeared. It is especially unfortunate that the weather conditions should have been so against them in the first year of the attempt.—GERARD H. GURNEY.

A DISTINCTIVE CHARACTERISTIC OF *SONCHUS PALUSTRIS*.—The accessible descriptions of the species of *Sonchus* are not sufficiently explicit, or there would be fewer cases of examples of varieties of *S. arvensis* being wrongly reported as *S. palustris*.

The rarer species is probably not as uncommon as it is generally supposed to be. Confidence may mislead a few, but caution deters more. An isolated plant should be regarded with suspicion—for where *S. palustris* does occur it will generally be found in crowded groups.

Having once been seen at home and recognized, *S. palustris* presents many points which distinguish it from *S. arvensis*, the trouble is to describe them in intelligible terms ; however, the following is offered as a reliable method of identification.

Cut a longitudinal section of part of the stem of the plant in question. If it is a tall example of a variety of *S. arvensis* the stem will generally, but not invariably, be found to be hollow, and the stem wall will show only a thickening at the nodes ; the hollow, wherever present, is a continuous one. *S. palustris* has a thin-walled, hollow stem, and invariably the hollow is interrupted at the nodes by thin septa. Each septum is well defined and the section is similar to that of a "bamboo" with very short internodes.

The ripe achenes of *S. palustris* are a little more deeply furrowed than those of *S. arvensis*, and their attachment to the pappus much less firm ; this last point may be one in favour of the plant's survival, for the seed is not carried far away into what might be unsuitable surroundings.—P. E. RUMBELOW.

ALBINO RATS.—Two pure white examples (male and female) of the Brown Rat were brought to me by a Taverham rat-catcher in March, 1926. Rats which are partly white, usually very large specimens, are often met with in stacks.

ABNORMAL SKATE.—In January, 1925, I met with a Thornback ray (*Raia clavata*) with a perfect fin, the size of my hand, standing erect upon the centre of the back, parallel to the backbone of the owner. It was probably more of a hindrance than a help to the fish. In all my experience I have only met with one other similar malformation in the Skate family, a Ray having two small fins, which had a tendency to affect a horizontal position. This was in July, 1892.

FOOD OF THE STURGEON.—It is my experience that it is seldom that a Sturgeon's stomach is found to contain any quantity of food ; here and there a few crustaceans are discovered, and in the intestines some amount of sand ; but in June, 1927, I had the good fortune to examine a freshly caught Sturgeon, measuring 4-ft. 6-ins., and weighing 26-lbs. I was curious to see if its stomach contained food of any kind, and asked the fish merchant who was exhibiting it to oblige me with its stomach.

He weighed it with its contents which scaled 15 ounces. On emptying the stomach into a dish, I took $13\frac{1}{2}$ ounces of lesser sandlaunces of some $2\frac{1}{4}$ inches length. Finding 54 fishes to the ounce, I found I had some 729 in all. Next day I was assured that quite a number of these fishes were discovered in the passages leading into the stomach.—ARTHUR H. PATTERSON.

ESTUARINE SHELLS IN THE BEDS OF EAST NORFOLK RIVERS.—In the Transactions, Vol. VIII., p. 855, I recorded the finding, in dredged mud at Ludham Bridge, of shells of Cockles, *Scrobicularia piperata*, and *Tellina balthica*. During the past summer Dr. Hankin showed me specimens of the two former species which he had found in mud dredged from the Hundred Stream near the entrance to Kendal Dike, and he subsequently found them also in 13 out of 15 localities visited along the Thurne River. It is of much interest to find that these estuarine species occur also so commonly in the Thurne. The appearance of the shells leaves no doubt that they actually lived in the places in which they are now found. The shells have been submitted to Dr. F. R. C. Reed, who considers that there is no evidence that they could have come from Crag deposits disturbed by the dredger. They must therefore represent, as was originally suggested, relics of the ancient estuary which occupied these valleys up to historic times.—ROBERT GURNEY.

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Copies of the TRANSACTIONS OF THE NORFOLK AND NORWICH NATURALISTS' SOCIETY can be obtained of the Hon. Librarian, Mr. F. C. Hinde, Oaklands House, Cringleford, Norwich, at the following prices. Those marked by an * are damaged by fire.

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Ordinary Members proposed and seconded at any meeting of the Society are balloted for at the next meeting. The Annual Subscription is 10s., payable in advance on election, subsequent subscriptions becoming due on the last Tuesday in March annually. This subscription may be compounded for by a single payment of £8.

Ladies or Gentlemen distinguished for their attainments in Natural Science, or who have rendered valuable services to the Society, may be nominated by the General Committee as Honorary Members, and elected by a show of hands at the next meeting of the Society. Such Honorary Members have all the privileges of Ordinary Members.

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