PROCEEDINGS

OF THE

Chester Society of Natural Science.

No. 1.

CHESTER:
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1874.

On Birds observed in Wirral, Cheshire,

BY

J. F. BROCKHOLES.

Birds of Wirral.

In offering this list to the Chester Society of Natural Science, I quite think it is not exhaustive. There is still a good field for enquiry amongst the land birds, and a better amongst the wading and swimming ones. The higher parts of the Estuary of the Mersey, including the Ince meadows, &c., as far as Runcorn and the Estuary of the Dee, with the enclosed and unenclosed marshes, are very worthy of research for the two latter tribes. The Avifauna of Wirral has changed a great deal in the last few years, and is still changing, through the agency of increased population and local alterations. The Falconidæ, some of the Corvidæ, and wild Fowl, are becoming scarce. Some birds which formerly nested in Wirral, have almost, if not entirely, ceased to do so.

I think none of the one hundred and sixty-eight species enumerated in the following list need a separate comment. Of these, of course, some are resident, some are summer visitors, some winter ones, whilst others are stragglers. Of the latter, the Black Swan is perhaps not yet admitted as an indigenous wild bird of Europe, but I believe is fast becoming so. I give all the species I know of which have occurred at large and leave them on their own merits.

The classification aud nomenclature are those of Yarrell's Work on British Birds, except in the instance of the Sand Grouse, which has occurred since the publication of the above-named book. The name and position in the list of that bird are indicated in Mr. Moore's communication. The black swan is noticed later.

RAPTORES.—Falconidæ.

White-tailed Eagle, Haliæetus Albicilla. I saw and shot at one, wounding it badly, some years ago, at Leasowe. This bird was afterwards found dead on a neighbouring field.

Hobby, Falco Subbuteo. Is occasionally obtained in spring (?) and autumn, in Burton and elsewhere.

Merlin, Falco Æsalon. Migratory, appearing here in spring and autumn. A few remain all winter on the Dee marshes, occasionally killing the ring doves which go there.

Kestrel, Falco Tinnunculus. Resident. I never knew this bird make a nest. The eggs are laid in Wirral on a repaired old nest of the sparrow-hawk, crow, rook, or magpie. Sometimes also in hollow trees.

Sparrow-hawk, Accipitor Nisus. Resident and common. This hawk always makes its own nest here. If this be robbed, a second is occasionally built; but generally the second laying of eggs is placed on any old nest which is sufficiently large. If robbed a second time, a third set of eggs is sometimes laid. I once found a third laying of eggs on some leaves which had accumulated in a fork of a tree,

Common Buzzard, Buteo Vulgaris. Seven or eight years ago, one was shot at Puddington. Two others frequented the Dee marshes near there the same autumn, preying on wild fowl.

Hen Harrier, Circus Cyaneus. In different years formerly, I have occasionally seen a Harrier. I never obtained one, and did not identify the species for certain. It was probably the above. Bidston Marsh.

Strigidæ,

Long-eared Owl, Otus Vulgaris. Resident in the fir woods of Bidston, Prenton Mount, Storeton, Ness and Burton. Sometimes also in mixed woods where there are Scotch firs, such as Badgers Rake wood, Ledsham. There are seldom more than one pair of old birds in a wood. Nidification commences in March. This owl never makes a nest for itself, but simply repairs the old one of a sparrow-hawk, crow, magpie or wood pigeon.

Short-eared Owl, Otus Brachyotus. Migratory here. Is occasionally met with in autumn. Sometimes some occur in winter on the sand hills near the Point of Air, Flintshire.

White or Barn Owl, Strix Flammea. Resident; but not so common as formerly.

INSESSORES.—Dentirostres.—Lanidadæ.

Red-backed Shrike, Lanius Collurio. A pair of these birds reared five young ones a few years ago, near Bidston.

Muscicapidæ.

Spotted Flycatcher, Muscicapa Grisola. A common summer visitor.

Pied Flycatcher, Muscicapa Atricapilla. On April 30th, 1867, I saw a rather shy, restles bird of this species in a wood at Burton.

Merulidæ.

Missel Thrush, Turdus Viscivorus. A common resident.

Fieldfare, Turdus Pilaris. A common winter visitor. Two or three years ago, a flock were constantly near the house. Two of these birds were frequently at an unfinished nest in a hedge; but all the flock departed before this was finished, and it never came to anything. Denhall.

A few years previously, I saw a Fieldfare on an unfinished nest. The bird forsook on being disturbed. Maghull, Lancashire.

Song Thrush, Turdus Musicus. An abundant resident. The nest is sometimes built on the ground in woods. I once knew one on the ground in the middle of a large field, at a considerable distance from any bush. I have known three instances of a nest in the cavity of an old magpie's nest.

Redwing, Turdus Iliacus. A common winter resident.

Blackbird, Turdus Merula. An abundant resident.

Ring Ouzel, Turdus Torquatus. An occasional visitor. In April, 1864, I found a nest containing four eggs at Puddington.

Sylviadæ.

Hedge Accentor, Accentor Modularis. An abundant resident.

Redbreast, Erythaca Rubecula. An abundant resident.

Redstart, Phœnicura Ruticilla. A scarce summer visitor. Eastham, Puddington. I once met with female specimen during severe weather in winter on the Leasowe embankment.

Stonechat, Saxicola Rubicola. Abundant in summer in suitable localities. This is a partial migrant here, the majority leaving in autumn whilst a few remain all winter.

Whinchat, Saxicola Rubetra. An abundant summer visitor.
Wheatear, Saxicola Œnanthe. An abundant summer visitor.

Grasshopper Warbler, Salicaria Locustella. A rather scarce summer visitor. Bidston, Bebington, Puddington. A nest has also been found near Upton.

Sedge Warbler, Salicaria Phragmitis. An abundant summer visitor.

Reed Warbler, Salicaria Arundinacea. A few years ago, this species might generally be detected as an annual summer visitor to the Bidston marshes.

Blackcap Warbler, Curruca Atricapilla, An abundant summer visitor.

Garden Warbler, Curruca Hortensis. I have twice detected this species, the first time in May 1860 at Prenton Mount, near Birkenhead; the second time in May 1861, at Puddington where I obtained a nest. R. Barton, Esq., tells me it annually visits Caldy. It is a summer visitor.

Lesser Whitethroat, Curruca Sylviella. Scarce in the north of Wirral. Common in some seasons at Denhall and Puddington. A summer visitor.

Wood Warbler, Sylvia Sylvicola. A common summer visitor.

Willow Warbler, Sylvia Trochilus. An abundant summer visitor

Chiffchaff, Sylvia Rufa. A common summer visitor.

Golden-crested Regulus, Regulus Cristatus. A common resident in fir woods.

Paridæ.

Great Tit, Parus Major. An abundant resident.

Blue Tit, Parus Cœruleus. An abundant resident.

Cole Tit, Parus Ater. A rather scarce resident.

Marsh Tit, Parus Palustris. An abundant resident.

Long-tailed Tit, Parus Caudatus. A not uncommon resident.

MOTACILLIDÆ.

Pied Wagtail, Motacilla Yarrellii. An abundant resident. I believe a number of these birds leave here in autumn.

White Wagtail, Motacilla Alba. In April 1869, I sometimes saw one, sometimes a pair of these birds. Leaving home at the end of the month I did not find the nest near Burton Rocks.

Grey Wagtail, Motacilla Boarula. Occasional in winter. This bird nests in Lancashire and Flintshire, but I am not certain that it does so in Wirral.

Ray's Wagtail, Motacilla Rayi. An abundant summer visitor.

ANTHIDÆ.

Tree Pipit, Anthus Arboreus. Rather scarce in the north of Wirral. Abundant at Ness, Burton and Puddington.

Meadow Pipit, Anthus Pratensis. An abundant resident.

Rock Pipit, Anthus Obscurus. This bird occasionally nests at Hilbre Island. I have seen eggs which were taken there.

CONIROSTRES.

ALANDIDÆ.

Sky Lark, Alanda Arvensis. An abundant resident. I believe this to be a partial migrant as I have seen flocks crossing the Dee marshes in autumn in a southerly direction apparently bent on a journey, numbers stay here all winter. The species is increasing numerically in Wirral.

Woodlark. Alanda Arborea. In April, 1859, I saw a rather wild unsettled bird at Claughton near Birkenhead. In May, 1861, I saw a pair of birds but failed to find the nest. Burton.

EMBERIZIDÆ.

Snow Bunting, Plectrophanes Nivalis. A rather scarce winter visitor.

Common Bunting, Emberiza Miliaria. I have never seen this bird here in winter. It is here in March, remaining during the spring and summer. It is common then in places such as Wallasey and the enclosed portions of the Dee marshes.

Black-headed Bunting, Emberiza Schæniclus. A partial migrant, abundant in summer; a few remain all winter.

Yellow Bunting, Emberiza Citrinella. An abundant resident.

Fringilidæ.

Chaffinch, Fringilla Cœlebs. An abundant resident.

Mountain Finch, Fringilla Montifringilla. An occasional visitor. I have seen this bird in March only.

Tree Sparrow, Passer Montanus. I am assured this bird nests near Bache House, Chester.

House Sparrow, Passer Domesticus.

Greenfinch Coccothraustes Chloris. Abundant in summer. I see a flock occasionally only in winter, and think the majority must go elsewhere for this season.

Goldfinch, Carduelis Elegans. A scarce resident. Birdcatchers in Wirral say that a good many come here in autumn.

Common Linnet, Linota Cannabina. An abundant resident.

Lesser Redpole, Linota Linaria. A rather scarce resident.

Bullfinch, Pyrrhula Vulgaris. A common resident.

Sturnidæ.

Common Starling, Sturnus Vulgaris. An abundant resident, and partial migrant. Countless thousands congregate in the autumn evenings to roost at Caldy and Thurstaston. The majority of these migrate before winter begins.

Corvidæ.

Chough, Fregilus Graculus. Some years ago I met with a flock of these birds in a field at Leasowe.

Raven, Corvus Corax. In the spring of 1857, a pair of ravens had a nest on the west side of Hilbre Island. For many years, ravens were abundant in winter on the Dee marshes, but I have not seen one since about the year 1866. I believe they were poisoned on account of the injury they do to sheep. I have known ravens to pick the eyes out of apparently a sound, healthy sheep, whilst resting, and so causing its death. After the eyes, the tongue and then the liver were the favourite morsels.

Carrion Crow, Corvus Corone. A very few years ago, this bird was common on the sealands, Shotwick, Burton, Saughall, and Puddington. The crow shared the fate of the raven, and at the same time. Ending with the year 1865, nests were common on the above named parishes and townships, but I have not seen one since. An occasional crow may still be heard whilst passing through the country.

Rook, Corvus Frugilegus.

Jackdaw, Corvus Monedula. A common resident.

Magpie, Pica Caudata. A much persecuted resident.

Jay, Garrulus Glandarius. A much persecuted resident.

SCANSORES.

Picidæ.

Green Woodpecker, Picus Viridis. An occasional visitor at all seasons, and I believe it occasionally nests in Wirral.

Great Spotted Woodpecker, Picus Major. An occasional visitor. Perhaps it is a scarce resident. In May, 1860, there was a nest in Patrickwood, near Bromborough mills.

Certhiadæ.

Common Creeper, Certhia Familiaris. A common resident.

Wren, Troglodytes Vulgaris. An abundant resident.

Cuculidæ.

Common Cuckoo, Cuculus Canorus.

FISSIROSTRES.

Halcyonidæ.

Kingfisher, Alcedo Ispida. A rather scarce resident. It is much sought for its beauty.

Swallow, Hirundo Rustica. An abundant summer visitor.

Martin, Hirundo Urbica. An abundant summer visitor.

Sand Martin, Hirundo Riparia. An abundant summer visitor.

Common Swift, Cypselus Apus. An abundant summer visitor.

Caprimulgidæ.

Nightjar, Caprimulgus Europæus. An abundant summer visitor to tbe fir woods of Bidston, Storeton, Ness and Burton, also to the open heath of Bidston hill.

RASORES.

Columbidæ.

Ring Dove, Columba palumbus. An abundant resident.

Stock Dove, Columba Ænas. A common resident. This species ordinarily nests in rabbit holes but I have known it nest in ivy growing on a wall close to the front door of a house. R. Barton, Esq., tells me that at Caldy, this bird sometimes nests on the ground under bushes of dwarf gorse as well as in rabbit holes.

Turtle Dove, Columba Turtur. A common summer visitor to Ness, Burton, and Puddington. I think also to the adjacent neighbourhood.

Pteroclidæ.

Pallas's Three-toed Sand Grouse, Syrrhaptes Paradoxus. On May 29th or 30th, 1863, two were seen at Hoylake, one of these was obtained in fine plumage and presented to the Derby Museum, Liverpool. Communicated by Mr. T. J. Moore, keeper of the Derby Museum.

Phasianidæ.

Common, Pheasant, Phasiœnus Colchicus.

Tetraonidæ.

Common Partridge, Perdix Cinerea.

Common Quail, Coturnix Vulgaris. A scarce summer visitor to Leasowe, Bidston, Rock Ferry, Bebington, Ness, and Burton.

GRALLATORES.

Charadriidæ.

Golden Plover, Charadrius Pluvialis. A common winter visitor. Sometimes there are many on the Sealands and Dee marshes.

Dotterell, Charadrius Morinellus. Has been shot on the shore a few years ago near Denhall. It is scarce.

Ringed Plover, Charadrius Hiaticula. Resident round the shores. Numbers also arrive in autumn to stay the winter or go further south.

Sanderling, Calidris Arenaria. Common in autumn on the Dee marshes. A few frequent the Leasowe shore in winter.

Grey Plover, Squatorola Cinerea. A few occur every winter in the Estuary of the Dee. I have seen large flocks of this or the Golden Plover on the shore near the Point of Air, Flintshire, and flying thence towards Mostyn. I think the flocks I have often seen there keep more to the shore than Golden Plovers generally do.

Lapwing, Vanellus Cristatus. An abundant resident.

Turnstone, Strepsilas Interpres. Scarce on the shores of Wirral. Has formerly been shot near Denhall.

Oyster-catcher, Hœmatopus Ostralegus. Abundant on the shores in autumn and winter. I have good authority for stating that it has been known to nest near Hoylake.

ARDEIDÆ.

Common Heron, Ardea Cinerea. Not uncommon. There was formerly a heronry at Hooton which may still exist there. There is a small one at Burton.

Common Bittern, Botaurus Stellaris. I have seen one which was shot in 1857 or 1858 by a farmer as it rose from a pond near Higher Tranmere.

White Spoonbill, Platalea Leucorodia. A specimen was shot about the year 1859 on the Dee marsh near Burton.

SCOLOPACIDÆ.

Common Curlew, Numenius Arquata. Common in autumn and winter round the shores.

Whimbrel, Numenius Phœopus. Occasional in autumn and winter round the shores. Sometimes a flock may be seen.

Spotted Redshank, Totanus Fuscus. A bird was killed about the year 1864, which from description was most probably referrible to this species. Dee marsh, near Burton.

Common Redshank, Totanus Calidris. Common round the shores in autumn and winter.

Green Sandpiper, Totanus Ochropus. About half a dozen occur every autumn at Puddington and neighbouring part of the Dee marsh. I have also seen an occasional one in ponds at Ness in autumn.

Common Sandpiper, Totanus Hypoleucos. A not uncommon summer visitor. Much less frequent than formerly.

Greenshank, Totanus Glottis. Occasionally in autumn and winter on the Dee marshes.

Bartailed Godwit, Limosa Rufa. Sometimes common in autumn on the Dee marshes.

Ruff, Machetes Pugnax. Several Ruffs were shot in spring some years ago in the Estuary of the Dee. A few young Reeves occur almost every autumn on the Dee marshes.

Woodcock, Scolopax Rusticola. More or less common in winter. During the spring of 1860, three or four pairs of Woodcocks frequented woods near Birkenhead until an advanced date. In the evening of August 24th, 1856, I saw a Woodcock between Bidston and Upton. I have also seen a Woodcock in one or two other instances in summer. I therefore think there is little doubt that this species occasionally breeds in Wirral although I have no authentic instance of a nest.

Common Snipe, Scolopax Gallinago. More or less common in autumn and winter. From having sometimes seen snipes in July and August, I judge a few breed in Wirral although I have no authentic instance of a nest.

Jack Snipe, Scolopax Gallinula. Until 1863, this was an abundant winter visitor. I have seen much fewer since that date.

Curlew Sandpiper, Tringa Subarquata. Not uncommon in autumn especially amongst Dunlins. Dee marshes.

Knot, Tringa Canutus. Abundant in autumn and winter in the Estuary of the Dee.

Little Stint, Tringa Minuta. Scarce on the shores in autumn and winter.

Temminck's Stint, Tringa Temminckii. On August 25th, 1862, I met with two of this species, one of these I shot. Dee marsh near Shotwick.

Dunlin, Tringa Variabilis. Abundant round the shores in autumn and winter. A few breed in suitable places in Wirral. In the spring of the year 1871, I received eleven eggs which were taken by a boy on the Dee marshes near Puddington and Shotwick.

Purple Sandpiper, Tringa Maritima. I have seen a specimen which was shot about the year 1866, on the shore near Parkgate.

Gray Phalarope, Phalaropus Lobatus. Occasional in winter on the marshes aud in the Estuary of the Dee.

Rallidæ.

Land Rail, Crex Pratensis. A summer visitor. Sometimes common.

Spotted Crake, Crex Porzana. One was picked up dead some years ago by a labourer at the end of summer or beginning of autumn under the telegraph wires on the Neston and Chester road, near Ness.

Water Rail, Rallus Aquaticus. In some parts of Wirral, this bird is not uncommon in winter.

Moorhen, Gallinula Chloropus. An abundant resident.

Lobipedieæ.

Common Coot, Fulica Atra. An occasional winter visitor. I saw one on March 24th, 1871, near Ness, but think it did not remain.

NATATORES.

Anatidæ.

Gray Geese. Flocks occasionally visit the Dee marshes which are locally called Grey Geese. I have examined only one specimen which proved to be a Bean Goose. Possibly the Grey-lag and Pink-footed Geese may be included in the term.

Bean Goose, Anser Segetum. On January 30th, 1872, I examined a bird of this species which was lately shot on the Dee marsh, near Burton.

White-fronted Goose, Anser Albifrons. Occasionally in winter on the Dee marshes.

Bernicle Goose, Anser Leucopsis. Prior to 1862, this species was very common on the Dee marshes, now it is very scarce, sometimes a whole winter passes without any being seen.

Brent Goose, Anser Torquatus. Sometimes flocks occur on the Dee marshes in winter.

Egyptian Goose, Anser Ægyptiacus. On November 8th, 1870, I saw one which had just been shot from a flock of four, when first seen, they were with some tame geese but were wary and had all the appearance of really wild birds. Dee marsh, near Denhall.

Canada Goose, Anser Canadensis. In the autumn of 1864, two of these birds frequented the Dee marsh below Puddington, firing a long shot at one one day I wounded it badly but failed to get it, I heard it was secured a day or two afterwards by a neighbouring gamekeeper.

Hooper, Cygnus Ferus. During the winter of 1870-71, Mr. Lawton of Denhall colliery shot a bird of this species on the Estuary of the Dee.

Bewick's Swan, Cygnus Bewickii. On December 18th, 1871, I examined a bird of this species which was shot by Mr. Lawton on the 14th, on the Estuary of the Dee.

Black Swan, Cygnus Atratus. One was caught some years ago on the Dee. This bird is not noticed in Yarrell's work. There is an account of it in the recent edition of Montagu's Ornithological Dictionary. See at the end.

Common Shelldrake, Tadorna Vulpanser. In summer and early autumn, many Shelldrakes bring their young on the tide to the Dee marshes and return with the tide. They nest occasionally on Hilbre Island and in suitable places on the Cheshire side of the Estuary of the Dee.

Shoveller, Anas Clypeata. A flock occurs occasionally in winter on ponds as well as on the Dee marshes.

Gadwall, Anas Strepera. Has been shot some years ago on the Dee.

Pintail Duck, Anas Acuta. Occasionally in winter on the Dee and marshes. In the winter of 1868-69, I shot a fine old male as it rose from a fresh water pond near Ness.

Wild Duck, Anas Boschas. Generally abundant in winter. A few nest in Wirral.

Garganey, Anas Querquedula. I have seen one which was shot some years ago on the Estuary of the Dee.

Teal, Anas Crecca. Common in autumn and winter, a few nest in Wirral.

Wigeon, Anas Penelope. Abundant in winter on the Dee marshes. I have known two instances of the Wigeon nesting and rearing young at Puddington. On July 20th, 1863, I shot a Wigeon at Puddington close to where some young ones were reared in the spring, this bird was very fat and very lousey.

Common Scoter, Oidemia Nigra. An abundant duck at sea off the north of Wirral. It occasionally comes to the Leasowe shore and is also sometimes storm driven to land.

Pochard, Fuligula Ferina. During the winter of 1869-70, a male bird was brought to me which had just been shot off a pond at Ness.

Scaup Duck, Fuligula Marila. Is occasionally shot in the Estuary of the Dee.

Tufted Duck, Fuligula Cristata. Occasionally met with on the Estuary of the Dee. I have seen it on the Dee marsh near Puddington.

Long-tailed Duck, Clangula Glacialis. Has been killed on the Estuary of the Dee.

Golden Eye, Clangula Vulgaris. From what I am told this is sometimes common on the Estuary of the Dee.

Goosander, Mergus Merganser. Occasionally occurs on the Estuary of the Dee and on the Dee marshes.

COLYMBIDÆ.

Great Crested Grebe, Podiceps Cristatus. Has been shot on the Estuary of the Dee. I believe this bird still breeds on some of the Cheshire meres.

Rednecked Grebe, Podiceps Rubricollis. Is occasionally obtained in the Estuary of the Dee.

Little Grebe, Podiceps Minor. Some years ago, I met with this species every winter in ponds and streams in the north of Wirral. I have not seen one in Wirral for ten or twelve years.

Red-throated Diver, Colymbus Septentrionalis. Concluding with the year 1860, this species was common in winter on the lake at Hoylake. I have not been there since nor have I seen a living specimen since.

ALCADÆ.

Common Guillemot, Uria Troile. Is sometimes met with on the Estuary of the Dee.

Little Auk, Mergulus Melanoleucos. Some years ago, I saw one in rough weather in winter on the Mersey. I have since seen one which was killed near Hoylake.

Razorbill, Alca Torda. Is occasionally met with in the Estuary of the Dee.

Pelecanidæ.

Common Cormorant, Phalacrocorax Carbo. Not uncommon at times in the Estuary of the Dee and on the Dee marshes.

Gannet, Sula Alba. We had an immature specimen stuffed which was killed some years ago on the Dee.

Laridæ.

Common Tern, Sterna Hirundo. Sometimes occurs in autumn on the Dee and marshes. I have seen it also on Bidston marsh. I believe this species formerly bred in Wirral.

Lesser Tern, Sterna Minuta. An autumn visitor to the Dee marshes.

Black Tern, Sterna Fissipes. I have seen one in autumn on the Dee marsh near Puddington.

Black-headed Gull, Larus Ridibundus. A few may be seen on the Dee marshes nearly all the year. Some must nest not far off.

Kittiwake Gull, Larus Tridactylus. Very common round the shores except in the nesting season.

Common Gull, Larus Canus. The remarks on the last species apply equally to this.

Lesser Black-backed Gull, Larus Fuscus. Is common round the shores except in the breeding season.

Herring Gull, Larus Argentatus. The remarks on the last species apply also to this.

Great Black-backed Gull, Larus Marinus. Occurs occasionally on the Dee. Is more frequent on the north shore of Wirral.

Common Skua, Lestris Catarractes. I have seen a Skua which was most probably this species. New Ferry.

Storm Petrel, Thalassidroma Pelagica. A fresh specimen was found dead a few years ago on the Dee marsh, near Puddington, and given to me immediately afterwards. In several instances I have seen a specimen of this Petrel flying on the Mersey between Woodside and the landing stage at Liverpool.

Black Swan. I am not certain that the bird referred to was really a wild one, it was either wounded or in an exhausted state. It was run down on the shore near Denhall colliery and afterwards kept alive for some time by Sir Pyers Mostyn, at Talacre, near Rhyl.

PHILLIPSON AND GOLDER, PRINTERS, CHESTER.

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BY G. R. GRIFFITH, GROSVENOR STREET.

1878.

TWO SHILLINGS AND SIXPENCE.

STIGMARIA

From the Coal Measures of Trefnant, near Ruabon

Vide p. 4.

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Stigmaria.

THE Autographic Print forming the Frontispiece was taken from a Photograph by Mr. G. W. Webster, F.C.S. This root was met with in the works of Mr. J. C. Edwards, of Trefnant, near Ruabon, and was placed in the Museum of the Society by Mr. G. W. Shrubsole, F.G.S. It occurred with many others in an underclay, overlain by two or three feet of sandstone and a thin coal. In course of removal it was detached from a stem which remained imbedded in the sandstone. The fracture resulting from the detachment is clearly shewn. Though found in the clay it is composed of sandstone, the bark having probably served as a mould in which sand collected after the removal of the more perishable interior by decay. An examination of the Print will shew the usual Sigillarian impressions.

Objects of a Natural Science Society.

At a General Meeting, held at the Old Palace, on Wednesday, the 25th October, 1871—*the Worshipful the* MAYOR OF CHESTER *in the Chair*—

A. O. WALKER, ESQ., read a Paper on the "Objects of a Natural Science Society." He referred to the advantages that would be derived if a local museum could be established. He suggested that three Sections be formed—viz., Geological, Botanical, and Zoological. It was afterwards resolved that the Botanical Section should meet on the first Thursday in each month; the Zoological Section on the second Thursday; the Geological Section on the third Thursday; and that a General Meeting of the Society should be held on the last Thursday in each month. He also urged upon the Society the desirability of thoroughly investigating the Natural History of its own district, and of attempting to show the connection between its Fauna, Flora, Soil, and Climate, and entreated them not to be discouraged even if no results appeared during the life-time of the present members, as it would only be by the comparison of data, accumulated by many such Societies, that such a connection would in all probability ever be traced. He further defined the district to consist of the six squares of the 1-inch Ordnance Survey, of which Chester is almost the centre, but excluding all on the other side of the Mersey.

[The above suggestions were adopted and have remained in force ever since; but a fourth Section of Natural Philosophy, to include the Physical Sciences, was subsequently added, and the district was enlarged by taking in the whole of the Counties of Flint and Denbigh.]

Observations on Phenomena connected with the Deposition of Sediment at the present day in the Estuary of the Dee, and their bearing upon older Deposits.

BY A. O. WALKER, F.L.S.

Read March 19th, 1874.

ONE of the difficulties that strikes the Geologist in our district is how to account for the great beds of brick-clay, such as you may see by the ticket-platform on the Holyhead line near the station, at Saltney, and elsewhere in the neighbourhood of Chester. It is, I think, tolerably evident that it cannot have been dropped as it now is, by an ice-floe, because it is pretty uniform in its character throughout hundreds of acres. There is also a strong presumption that it is derived from the rocks in its immediate neighbourhood, for its colour is the same as the New Red Sandstone. Is it not, therefore, possible, that it is the result of the grinding action of some great sheet of Ice or Glacier, such as now overspreads the surface of Greenland, which ground the Keuper Marls of the Cheshire Hills, previous to the last submergence of the land, into red mud? When the land then became submerged, this would be washed down by the sifting action of the water into the deepest parts of the sea, where it would lie comparatively undisturbed. Then there would float over it sheets of coast-ice, carrying with them, adhering to their underside, pebbles from the shores where they had been formed, and these, if the water were tidal, as it probably was, would constantly ground on the banks, there melt, or drop their stones while still floating, from the gradual melting of the ice by the water. That this is no imaginary process can be proved by the fact (for which I am indebted to my friend Mr. Dick, a most careful and accurate observer) that it may be seen in action at this day whenever there occurs a frost severe enough to form masses of ice on the Dee. For after such a frost, the mud banks off Flint and Bagillt may be seen thickly sprinkled with stones, the masses of ice that have brought them having melted, but in a short time all these stones have vanished. They must have either sunk into or been covered up by the mud. But the latter hypothesis is hardly tenable, as it involves a rise in the height of the banks much more rapid than actually occurs, so that we are driven to the conclusion that they must have sunk into the mud, though it is a question how far they would sink. This might explain, in many cases, the occurrence of the pebbles thinly scattered through the brick-clay, for had they been deposited at the same time as the clay, they would have been arranged more regularly in layers or strata according to their size, &c.

The bed of the Dee offers a good example of the danger of inferring, from the difference in character of deposits, that they were not of the same age. If anybody will walk across the Dee from Bagillt to Parkgate he will find that he passes over some strikingly different deposits, all of which, however, are going on simultaneously, and side by side. First in order, he will come to a greasy, slippery mud, so riddled by the burrows of a small Crustacean *(Corophium longicorne)*, and a Nereid worm, that, of the former especially, every square foot of mud contains many hundreds. When this mud is dug into it is blackish in colour, and has an offensive smell; and at a lower depth than the animals above-named, are found many specimens of a large shell-fish, *Mya truncata.* It has always struck me that this mud would, in the course of time, acquire much the same appearance as the flag-stones we saw last summer in the Quarry at Greenfield, and which belong to the lower Coal Measures. Well, continuing our walk, we should reach, about a mile from the shore, large banks of wet sand, which are the chosen home of Cockles, Lug-worms, and two or three other species of Bivalve-shells, which do not occur nearer the shore. Further out still are beds of pure sand, which the natives call "chaffy banks," from their dry and chaff-like character. I believe these to be almost, if not quite, devoid of animal life. On the other side of the river, in Dawpool, where the water is deeper, you get mud again, but now inhabited by great quantities of mussels, which do not occur at all on the Welsh side. Thus you will see how great a variety of totally dissimilar deposits are going on simultaneously in a small area, and for the most part between high and low water mark of the most ordinary tides. I cannot but think that the only chance of unravelling the tangled skein of difficulty that surrounds the phenomena of the boulder clay, lies in a careful examination of such deposits as are going on at the present day, and I would strongly recommend the estuary of the Dee as a promising field for such investigation.

The sand deposited by the river reaches (in places, at all events) to a great depth. Mr. Johnson who superintended the sinking of the shaft of the Bettisfield Colliery at Bagillt, informs me that they sank through 50 to 60 feet of river sand before reaching the clay. On the surface of this clay they found large boulders partially embedded in it. The under-side of the boulders was more or less angular, while the upper surface was rounded as if by the action of the waves, or perhaps of fine gravel and sand continually driven over it by the current. Attached to the stones were oyster shells showing that the stones had not been shifted from the position they occupied when the oysters upon them were living. At that time, if there had been no subsidence since, the water immediately under the high bank which runs all along the river must have been 50 or 60 feet deep; but as I believe this is a greater depth than oysters usually inhabit, and bearing in mind the submerged forests at Leasowe on the one side, and Llandrillo on the other, we are justified in concluding that though the actual bed of the river has been raised by silting up, yet there has been a general subsidence of the whole coast.

Notes on the Lower Coal Measures between Bagillt and Holywell.

BY A. O. WALKER, F.L.S.

Read March 21st, 1878.

THE traveller to Holyhead will see on his left, between Queen's Ferry and Mostyn Stations, a line of hills sloping down to the shore of the Dee with a higher range behind them: the latter is the carboniferous limestone range, known as Halkin Mountain; and the former, with which we have to do to-night, is mapped by the Geological Survey as partly coal-measures, and partly—in the rear from the Railway—as mill-stone grit. Up to the Dee Bank Smelting Works, about one mile beyond Bagillt Station, the slope of the hill is true coal-measures, as shown by numerous collieries on it; but close to this point, a fault running N. and S. (known locally as the "Boot" fault) has thrown out the coal bearing strata, and no coal has been got from this point to the Englefield Colliery, a little beyond Holywell Station.

Going inland from this point towards Holywell, the first section we get is some distance from the high road to the South, in a dingle below a farm called Garreg Lydan (Cerrig Llwydion on the Ordnance Map), where there is a quarry, in which beds of coarse-rippled micaceous sandstones, sometimes over 3 feet thick, and soft interbedded shales, occur. The dip here is about 5° N.-E. No organic remains, except perhaps some imperfectly preserved plant remains, have been observed here by me. (I may mention, by the way, that there is here a fine section on the top of the sandstone of boulder clay, with eroded hollows filled up with gravel, and with large angular fragments of sandstone, similar to that *(in situ)* beneath it, resting on the clay under the gravel.) Leaving this and returning to the Holywell Road, we come, soon after passing Glyn Abbot, to a thick mass of thin shales; and here a level has been driven into the hill-side for the purpose of getting the aluminous limestone, locally known as cement stone. As these workings have not proved so profitable as those further on, and there is less material for examination, it will be well to leave them and go on till we come to a road turning to the left down a steep hill. At the bottom of the valley, to the right of the road, the cement beds are being worked vigorously, and a large quantity of shale has been thrown out in the course of the operations, which will well repay a careful examination. These beds, though apparently much lower, are really at almost exactly the same level as those on the Holywell Road. The dip in both cases is difficult to make out, but seems to be S. E. at 13° or 14°.

The cement stone itself occurs in two beds, about 15in. and 18in. thick respectively, and separated by a bed of shale. They are worked by means of a level or gallery driven along their course. The stone, which contains a large proportion of alumina and comparatively little carbonate of lime, is burnt, and produces a lime similar in its properties—though by no means equal in quality—to the celebrated Portland cement, and must not be confounded with the so-called Aberdo lime, which is obtained from the quarries on the slope of the hill, above the Holway Mine, on the other side of Holywell. These last belong to the upper measures of the carboniferous limestone, and produce a hydraulic lime which is extensively used for building in water, but is only worth about 25/- a ton; while the cement, when burnt and ground, is worth about 42/-. The cement beds appear, from their fauna and flora, to belong rather to the coal-measures proper than even to the millstone-grit—if this last is to be distinguished at all from the coal-measure sandstones. Assuredly there is a very marked difference between the millstone-grit of Hope Mountain, and these rotten shales!

The fossil organisms found in the cement stone and accompanying shales have quite the estuarine character that is so distinctive of the lower coal-measure shales. The plants, which are very abundant, consist of *Sigillaria* and *Lepidodendron*, and grass-like leaves. The shells are *Posidonomya Gibsoni* (very abundant), *Aviculopecten papyraceus*, *Goniatites*, and *Bellerophon*. Prof. Hull ("Coalfields of Great Britain," p. 71) gives a section of the lower coal-measures or Gannister series, the topmost strata of which consists of "black shales with *Aviculopecten*," and "shales containing *Goniatites*." This would seem to point to the same horizon as the beds under consideration.

The most interesting fossils that are found in these beds are the Coprolites of fish, which occur as irregular nodules. At my request Mr. Siddall kindly polished some of these, and was so much struck with their appearance that he sent them to Mr. Cuttell, of London, by whom specimens were mounted as transparent objects for the microscope, by which their coprolitic character was placed almost beyond a doubt. They contain the small bones or scales of fishes—such, at least, is the opinion of Mr. Etheridge, who not only kindly examined these sections, but also named the other specimens of shells, &c., for which I have to thank him. In his opinion there is a strong probability that the Coprolites are the ejectamenta of *Megalichthys* or *Rhizodus;* and considering their abundance, it is remarkable that no remains of the fish themselves have been found. I should add that analysis shows the Coprolites to contain a large proportion of phosphate of lime.

From the above-named organisms and the lithological character of the beds in which they occur, I venture to doubt the propriety of placing them in the millstone grit. It appears probable that the line ought to be drawn along the valley in which they are found, leaving the narrow strip between that and the top of the mountain, where so many lead veins are mapped, as the true representative of that formation. It is in this strip that the Chert Beds are found; and I cannot help thinking that these beds are really a particular condition of the millstone-grit. In the neighbourhood of the Minera Mine, near Wrexham, almost every gradation, from a coarse sandstone to true chert, may be found; and the terms millstone-grit and chert are almost convertible among the more educated lead miners.

About one mile North of the cement-stone quarries, and behind Greenfield Hall, is a large flag-stone quarry. These beds consist of numerous strata of coarse micaceous sandstone from about 2in. to 1ft. thick, and containing *Anthracosia*, and casts of worm burrows, suggesting a more brackish water formation than the last. This is also higher up in the series, coming near the coal-bearing measures, though it is also coloured in the map as millstone-grit. Here again it seems probable that the valley by Holway Mine is the true boundary between the coal-measures and the millstone-grit.

[Since the above Paper was read, my friend MR. STRAHAN has found an unmistakable millstone-grit *Breccia* in the "narrow strip" referred to above.]

Origin of Rock-Salt.

BY GEORGE W. SHRUBSOLE, F.G.S.

Abstract of Paper read November 23rd, 1876.

THE notion that salt was of igneous or volcanic origin has long since been exploded, and I propose to give some of the reasons that may be adduced in support of the theory that rock-salt has been derived from the evaporation of water.

If we take a quantity of sea-water—say from the Mediterranean—we find that it contains the following ingredients :—

Carbonic Acid	Chloride of Sodium
Oxide of Iron	Sulphate of Magnesia
Carbonate of Lime	Bromide of Sodium
Sulphate of Lime	Chloride of Potassium

These constituents of sea-water may vary somewhat in their relative proportions, from local circumstances, but they will be found invariably present in sea-water, whether from the Atlantic or the Pacific Ocean, or even the Arctic seas.

Now, if rock-salt be due to the evaporation of sea-water, we ought to find with the rock-salt some traces of the several bodies above-mentioned.

This is what we actually do find in every salt mine in which there are facilities for exploration; there occur thin bands of limestone, thick layers of sulphate of lime, immense masses of chloride of sodium, and last, though not the least in importance, the bromine and potash salts, which in the German salt mines occur so freely as to be worked for commercial purposes. In fact, every item in sea-water down to iodine, has been found, when sought for, in the rock-salt beds. This is the first chain in the link of evidence.

It might be supposed that if rock-salt is due to the drying up of salt-water, we ought to find the several ingredients, not as we do in consecutive layers, but mixed together in a confused mass. Such might seem to be a proper inference to anyone not acquainted with the laws which govern the deposition of those ingredients.

What actually occurs when the salts of sea-water are separated by evaporation may be known by experiment, and is as follows: We may be supposed to be operating upon a considerable body of sea-water. The first application of heat drives off the gaseous matters, including the carbonic acid gas. When 46 per cent. of the water has been evaporated, by the disappearance of the carbonic acid, the iron is reduced to oxide and quickly falls to the bottom, and if clay be present, unites with it, giving to it the reddish tint common to the marl. Continuing the boiling process, when 70 per cent. of the water has disappeared, the bicarbonate of lime parts with an equivalent of carbonic acid, and becoming the insoluble carbonate of lime, falls as a powder to the bottom. When 90 per cent. of the water has gone, the sulphate of lime having reached its point of saturation, falls to the bottom also. When the water has lost 6 per cent. more, it comes to the turn of the chloride of sodium, and as the largest ingredient present, it forms a thick layer on the sulphate of lime. Lastly, at 98 per cent., the salts of magnesia with the bromine are thrown down. No one can fail to admire the regular order in which the various salts have left the sea-water: each has been held in its place by its law of solution. When the water can no longer hold the salt it falls to the bottom. This experiment will explain how it is that when salt-water deposits its saline particles, it does not lay them down in a promiscuous, but in a consecutive manner.

So far our experiment has been in favour of the origin of rock-salt from sea-water, since we find in salt mines a similar arrangement in masses or layers.

We may carry the argument still further, for not only do we find in the rock-salt mines the ingredients of sea-water; but what is of importance, the relative proportions of these ingredients are nearly similar to those in sea-water.

Thus, the chloride of sodium is largely in excess of everything else, the next in proportion is the sulphate of lime, and the rest in much reduced quantities. Out of the hundreds and thousands of chemical salts which make up the bulk of inorganic chemistry, where we find six of these associated in a state of solution, it is very natural to infer, when we meet with the same six forming a solid deposit, that the connection is the result of some natural law and not one of mere accident, and that our salt deposits in Cheshire are due to the evaporation of sea-water. It was "no fortuitous concourse of atoms" which had brought these identical bodies together under such different circumstances.

In confirmation of this theory, we can point to an instance in which the operations we have indicated have long been in existence, and are now well nigh approaching completion. I allude to the vast salt deposits in and around the Dead Sea. The following details may not be out of place:—

The great depression in the Jordan Valley is 150 miles in length, with a breadth of 12 miles. The lowest point in it is occupied by the Dead Sea, some 46 miles long, and an average width of 10 miles. On both sides of it there are mountain ranges which run parallel with it. The surface of the Lake is 1292 feet below the level of the Mediterranean. Its greatest depth is 1308 feet, giving a total depression below the Mediterranean of 2600 feet. The Jordan flows into the Lake at the North end. There is no outlet for its water. A column of water, 20 feet in depth, is annually evaporated. Its specific gravity is 1·228, water being reckoned at 1·000. It contains over 26 per cent. of saline matter, which is a trifle more than the best brine springs in Cheshire, mainly made up of the rarer forms of salts found in sea-water. Deposits of common salt occur at the height of 300 feet above the water, and are from 100 to 150 feet in thickness, and extend for five miles along the shore.

Let us see the bearing of these facts upon our subject. In later geological times, when the Asian continent arose from its submergence, it must have enclosed a column of water equal in height to the difference between the level of the Mediterranean and the lowest depth of the Dead Sea; this would give 2600 ft. This sea must have covered a considerable extent of country, much of it is still below the Mediterranean. Lake Tiberias, 60 miles distant from the Dead Sea, is 84 feet below the level. This body of water has now all been evaporated, and the patch of briny water which now forms the Dead Sea is all that is left. An analysis of its waters shows that it has long since passed the eleventh hour of its existence, has deposited most of its common salt, and represents an accumulation of sea-water after parting with 99 per cent. of its substance, and is undergoing further concentration. It is, in fact, what is known to chemists as a "Mother liquor," being made up of salts which exist only in an infinitesimal degree in sea-water, but which now preponderate to the exclusion of common salt and gypsum, which have long since left the water, and are to be seen as rock masses extending for miles, and as thick as anything of the kind we have in Cheshire. This is apparent to the eye, but what of the deposit of marl and salt at the bottom of the sea? Who is to estimate its thickness? The probabilities are that the salt beds below the surface are far more extensive than those above.

Intimately connected with rock-salt are the well-known marl beds. Their presence is a sort of geological puzzle. JUKES, in his *Manual*, observes "The accompaniment of rock-salt with the red and variegated clays has not yet been explained. When it is, it will probably throw great light on the circumstances under which the rock-salt itself has been deposited." The difficulty here is, I imagine, finding rock-salt and marl beds together, ranged layer upon layer, salt and marl, or crystal and clay,—two bodies of very opposite appearance and character. I shall endeavour to account for the presence of the marl beds, which I conceive will throw additional light on the origin of rock-salt.

Marl, be it remembered, is but a hardened clay, with an extra quantity of saline matter. The circumstance of finding marl associated with these salt beds, shews that there were in existence older and perhaps similar beds, which at this time became denuded and redeposited. How was this done? What is the principal, I might almost say the only, agent employed in the redistribution of clay? It is water. Here comes in a singular fact. All waters do not behave themselves in the same way in the presence of clay. Sea-water has little or no affinity for it; while river-water intimately combines with it. It is true that the union is mechanical, but still so thorough that a week is scarcely sufficient for its redeposition. Take the action of the River Dee as an illustration. A rainfall, followed by a flood, occurs, say in the upper waters, and clay finds its way from the soil into the river, until its waters are yellow with it. It does not settle, but flows on with the stream down to the mouth of the river, where, meeting with the salt-water, it quickly settles, and with the silt forms an awkward bar or sand-bank, at the junction of the fresh with the salt-water. This can also be made the subject of an interesting experiment. Stir an equal amount of clay into a glass vessel of ordinary water, and another of salt-water, and notice the difference in action; the one quickly settles, the other may be days about it; the rule would appear to be, the denser the solution the quicker the deposition. Let us apply this. Rock-salt has been undoubtedly deposited from the waters of a salt-lake, with a river flowing into it, as in the case of the Dead Sea. If rivers now bring down clay, why not this river flowing into the salt-lake. I can see nothing forced in this supposition; on the contrary, the great thickness of these marl beds points, not merely to the fact of a river discharging its contents into the lake, but that a very muddy river, full of clayey matter in suspension, found its way there, which material, as soon as it mingled with the sea-water, would fall to the bottom and become a marl. The clay would be deposited at once on reaching the salt-water, and this would go on for ages, during which time no salt would be formed, while a continuous growth of marl would be going on. The existence of these marl beds beneath the rock-salt can, in this way, and consistently with known laws, be accounted for.

Again, we should expect to find the marl deposits occupying a far wider area than the salt which it underlies, which is precisely what we do find; and it ought to be so if our theory be correct. Marl would be deposited from the very beginning of the lake's existence. Salt would not form until the lake had reduced its volume by $\frac{9}{10}$ths. I am aware that I am here in conflict with many geologists, who generally manage for the sea to flow into a depressed area of land, and form a lake, and the sun to dry up the water. In this way you may get salt, but where is the marl?

To complete the story of the origin of rock-salt, I propose now to review the physical state of things, hereabouts, in Triassic times, more particularly in reference to the formation of rock-salt. I shall confine my remarks to what we may suppose to have occurred in the locality of the Cheshire basin, leaving out of the question the existence of similar lakes in other parts of the Trias area.

First of all we have evidence of the existence of a considerable hollow or depression, on the site of the present salt districts, now filled up with material of Trias date. The present thickness of these salt and marl beds is a thousand feet at the least; this only partly indicates the depth of this hollow, which, when first cut off from the sea, would necessarily be salt-water, and by subsequent evaporation, its waters would become more salt, until in time it became, from the preponderance of salt, a salt-lake.

What have we now to replenish this lake with from time to time? A body of sea-water alone, undergoing evaporation, would not supply all the necessary elements in the case. There must of necessity have been the drainage off saliferous and clay lands. This brings in river action There is evidence that a river or current from the north brought down, from a conglomerate of the Old red-sandstone, the pebbles which we now find scattered in the Bunter sandstone. This river could furnish our lake with waters more or less saline, and while so doing bring down the material for the marl.

To secure our lake from the encroachment of the sea, we require higher land to encircle it. Of this land we have some trace left in Wirral, and more in the Beeston, Helsby, and Overton Hills; while to attest that it was land, we have, in the places mentioned, foot-prints of *Labyrinthodon*, plant remains, sun-cracks, and possibly rain-pits. We have here all the machinery for the production of rock-salt, down even to the sun; the effect of whose rays are still visible in the cracked and shrivelled appearance of the so-called "water-stones."

It is obvious that, in the first instance, when the sandy barrier shut out the ocean from the little Cheshire lake, it would enclose a body of sea-water of considerable expanse, and as we have seen, 2000 feet in depth probably.

This body of water would undergo evaporation summer by summer, and as the loss in this way was greater than any inflow, it was only a question of time before the waters became brine, and from brine, salt. Before, however, this could be accomplished, and as the waters lessened in bulk, they would naturally retreat to the lowest levels, which happened to be along the present valley of the Weaver, where we now find the greatest thickness of salt deposits.

We have rather anticipated in our sketch, for salt would be almost the last thing deposited from the waters of the lake. Not until more than $\frac{9}{10}$ths of the water had evaporated would one grain of salt be deposited, and only when the lake had diminished from its former noble proportions to less than $\frac{1}{10}$th of original size and volume, would the salt separate.

While all this had been going on, we may believe that the river, to which we made allusion, had not been inactive. Its muddy waters from the far north would come down laden with alluvial matters into our salt-lake, and in contact with its saline water would soon deposit. This would commence from the first inrush of its waters into the lake, and would continue to fall as long as the waters flowed in. This deposit we now call the Keuper Marl, and it forms the bed on which lies the rock-salt. Judging from the thickness of this marl deposit, it must have occupied a considerable period in formation.

As a matter of fact the order of deposition would be marl and oxide of iron, as a first deposit; then carbonate of lime if present; and, when three-fourths of the water had been dissipated, the sulphate of lime or gypsum would form itself into a solid mass. A long pause would now ensue; the waters would continue to decrease until but a remnant remained, and the salt commenced to settle at the bottom of the lake. Now each particle of water evaporated means the settling down of a fragment of salt; so that the result of a summer's evaporation of the water would be the accumulation of a thickness of salt, such as we do not often meet with in other formations. Many feet of salt would be the result of a summer's operation.

I have thus briefly sketched the course of events which one may justly believe to have been the origin of the rock-salt of Cheshire.

We may also now understand why it is that the deposit of rock-salt occupies a very limited area, since, as we have seen, it is only when a lake diminishes to the size of a large pool that the salt in it deposits.

This is not the end of these salt deposits, for in looking at a section map of the district, we notice that a bed of marl caps the rock-salt as well as underlies it. How is this to be accounted for? Some geologists will tell us that the land was sinking, and, to fit in with their theory, in the same ratio as the marl and salt were deposited. My own conviction is that nothing of the kind occurred. It is a kind of geological "see-saw" which I consider to have been impossible. Well then, you ask how do I account for this second bed of marl overlying the salt? A very fair question. All I conceive to be required, is to imagine the river, for a time, ceasing to flow into the lake, or its waters diverted. Its volume had evidently been diminishing, or the salt-rock could not have accumulated. Fancy then, and there is nothing extravagant in the idea, the river silted up, and the waters turned aside. A summer or two would suffice to turn the mass of briny water into a hard rock, and there we leave it—a perfectly formed bed of rock-salt. So things would remain until some rainy season, when floods swept the country, and sent their foaming waters along the old course of the river; it is not wonderful if it broke down the temporary barrier, and once more flooded, with its mud-laden waters, the floor of rock-salt in the old lake.

What would then happen? There was sufficient saline matter present to cause the clay to settle and cover the bed of salt. This would continue for a lengh of time, and under similar conditions to the first bed; the result would be a considerable deposit of marl. In this way we may account for the second set of beds, by alternately shutting out and letting in a supply of suitable water. The diversion of the supply of water gave rise to the salt, the letting in of more water produced the marl.

I am conscious that I have but imperfectly fulfilled my object in endeavouring to solve some of the many problems connected with the formation of rock-salt; and as an humble effort in that direction, I now submit it to the consideration of the geological student.

The Drift Deposits of West Cheshire.

BY W. SHONE, F.G.S.

Read January 31st, 1878.

DURING the making of the Midland Company's Line from Mouldsworth to Chester, interesting Sections of the Drift deposits were exposed, especially in the Newton cutting, about a mile and a half from the Victoria Station, Chester. In the Upper Boulder Clay of the Newton Section I have found 56 species and varieties of Mollusca; 2 Polyzoa, 26 Ostracoda, 2 Cirripedia, 2 Annelida, 3 Echini, 2 Spongida, and 55 Foraminifera, or in all 148 species and varieties of marine animals' remains. From a sand-pit, owned by SIR P. DE M. GREY-EGERTON, BART., M.P., F.R.S., at the village of Upton, about two miles from Chester, MR. G. W. SHRUBSOLE and myself have gathered 23 species of Mollusca.

In the Lower Boulder Clay of the cliffs of Dawpool, Wirral, Cheshire, MR. D. MACKINTOSH, F.G.S., and myself have found 35 species of Mollusca, in addition to which I have also obtained from this locality 1 Polyzoa, 13 Ostracoda, 1 Cirriped, 1 Annelid, 2 Echini, 2 Spongida, and 32 Foraminifera.

The whole of the Microzoa were obtained from the sand which fills the internal chambers of the Univalve Mollusca in the Upper and Lower Boulder Clays. A most interesting fact, bearing upon this subject, was observed by my mother, MRS. SHONE, who, upon examining some silt gathered from Gorteen-beach, Connemara, by Mr. R. D. DARBISHIRE, B.A., F.G.S., found that the dead shells of the fry of the Gastropoda in the silt, were filled with Microzoa similar to those in the Boulder Clays.

The very limited space at my disposal prohibits my making any remarks upon the facies of the Fauna, or the climatic changes it indicates; this, however, is rendered less necessary, as the subject is fully discussed in my Papers published in the Quarterly Journal of the Geological Society of London—viz., Vol. xxx., p. 181, "On the Discovery of Foraminifera in the Boulder Clays of Cheshire," and Vol. xxxiv., p. 383, "On the Glacial Deposits of West Cheshire, together with Lists of the Fauna found in the Drift of Cheshire and adjoining Counties."

I have to acknowledge the great assistance I received from the following gentlemen who have identified the names of the species from the specimens from time to time submitted to them, viz.:—The Mollusca, J. Gwyn Jeffreys, Esq., LL.D., F.R.S.; the Ostracoda, the Rev. H. W. Crosskey, F.G.S., and G. S. Brady, Esq., F.L.S., F.G.S.; and the Foraminifera, Mr. J. D. Siddall.

Foraminifera.

	Upper Boulder Clay, Newton.	Lower Boulder Clay, Dawpool.
Cornuspira involvens, *Philippi*	*	
Biloculina ringens, *Lamk.*	*	*
—— elongata, *D'Orb.*	*	
Triloculina trigonula, *Lamk*	*	*
—— oblonga, *Montagu*	*	*
Quinqueloculina seminulum, *Linn*	*	*
—— bicornis, *W. & J.*	*	
—— secans, *D'Orb.*	*	
—— subrotunda, *Montagu*	*	*
—— agglutinans, *D'Orb.*	*	*
—— Ferussacii, *D'Orb*	*	
Lituola scorpiurus, *Mont.*	*	
—— canariensis, *D'Orb.*	*	
Lagena sulcata, *W. & J.*	*	*
—— lævis, *Montagu*	*	*
—— striata, *D'Orb.*	*	
—— semistriata, *Will.*	*	
—— globosa, *Montagu*	*	

FORAMINIFERA—*con.*

	Upper Boulder Clay, Newton.	Lower Boulder Clay, Dawpool.
Lagena marginata, *W. & J.*	*	
—— lucida, *Will.*	*	*
—— squamosa, *Montagu*	*	*
Nodosaria scalaris, *Batsch*	*	
—— radicula, *Linn.*	*	*
—— pyrula (?), *D'Orb.*	*	
Dentalina communis, *D'Orb.*	*	*
Cristellaria rotulata, *Lamk.*	*	*
—— crepidula, *F. & M.*	*	*
Polymorphina communis, *D'Orb.*	*	
—— lactea, *W. & J.*	*	
—— compressa, *D'Orb.*	*	
—— myristiformis, *Will.*		*
Uvigerina angulosa, *Will.*	*	
Orbulina universa, *D'Orb.*	*	
Globigerina bulloides, *D'Orb.*	*	*
Textularia variabilis, *Will.*	*	*
—— globulosa, *Ehrenb.*	*	
—— pygmæa, *D'Orb.*	*	*
—— difformis, *Will.*	*	*
Bulimina pupoides, *D'Orb.*	*	*
—— marginata, *D'Orb.*	*	*
—— aculeata, *D'Orb.*	*	
—— ovata, *D'Orb.*	*	*
—— elegantissima, *D'Orb.*	*	*
—— spinulosa (?), *Will.*	*	
Virgulina Schreibersii, *Crjzek*	*	
Bolivina plicata, *D'Orb.*	*	*
Cassidulina lævigata, *D'Orb.*	*	
—— crassa, *D'Orb.*	*	*
Discorbina rosacea, *D'Orb.*	*	
—— globularis, *D'Orb.*	*	
Planorbulina mediterranensis, *D'Orb.*	*	
Truncatulina lobatula, *Walker*	*	*
—— refulgens, *Mont.*	*	
Pulvinulina repanda, *F. & M.*	*	
Rotalia Beccarii, *Linn.*	*	*
—— nitida, *Will.*	*	*
Patellina corrugata, *Will.*	*	
Polystomella crispa, *Linn.*	*	
—— striato-punctata, *F. & M.*	*	*
Nonionina umbilicatula, *Montagu*	*	*
—— depressula, *W. & J.*	*	*
—— asterizans, *F. & M.*	*	*

OSTRACODA.

	Upper Boulder Clay, Newton.	Lower Boulder Clay, Dawpool.
Cythere pellucida, *Baird*	*	
—— tenera, *Brady*	*	*
—— cribrosa, *B., C., & R.*		*
—— finmarchica, *G. O. Sars*	*	
—— villosa, *G. O. Sars*	*	
—— concinna, *Jones*	*	*
—— tuberculata, *G. O. Sars*	*	*
—— Dunelmensis, *Norman*	*	
—— Whiteii, *Baird*	*	
—— antiquata, *Baird*	*	
—— Jonesii, *Baird*	*	
Cytheridea papillosa, *Bosquet*	*	*
—— punctillata, *Brady*	*	*
—— Sorbyana, *Jones*	*	
Eucythere argus, *G. O. Sars*	*	
Krithe Bartonensis, *Jones*		*
Loxoconcha impressa, *Baird*	*	
—— guttata, *Norman*	*	*
—— tamarindus, *Jones*	*	*
Cytherura striata, *G. O. Sars*	*	*
—— angulata, *Brady*	*	
—— producta, *Brady*	*	
Cytheropteron latissimum, *Norman*	*	
—— nodosum, *Brady*	*	*
—— montrosiense, *B., C. & R.*		
Sclerochilus contortus, *Norman*	*	
Paradoxostoma ensiforme, *Brady*	*	*
—— flexuosum, *Brady*	*	*
—— arcuatum, *Brady*	*	

LIST OF MOLLUSCA, &c., FROM THE DRIFTS OF WEST CHESHIRE.

In the Tables of Mollusca, v r means that 1 to 3 specimens have occurred; r, 3 to 10; f, frequent; c, common; a, abundant; v, very.

	Lower Boulder Clay, Dawpool.	Middle Sands and Gravels, Upton.	Upper Boulder Clay, Newton-by-Chester.
Anomia ephippium, *Linné*	..	..	v r
Ostrea edulis, *L.*	..	r	f
Pecten opercularis, L.	r	r	f
Mytilus edulis, *L.*	v r	r	f
—— modiolus, *L.*	v r	r	f

LIST OF MOLLUSCA, &c.—*con.*

	Lower Boulder Clay, Dawpool.	Middle Sands and Gravels, Upton.	Upper Boulder Clay, Newton-by-Chester.
Nucula nucleus, *L.*	..	..	v r
Leda pernula, *Müller*	r	..	v r
Pectunculus glycymeris, *L.*	..	..	f
Arca lactea, *L.*	..	..	v r
Cardium echinatum, *L.*	c	c	a
—— tuberculatum, *L.*	v r		
—— edule, *L.*	a	a	a
——norvegicum, *Spengler*	v r		
Cyprina islandica, *L.*	f	f	a
Astarte sulcata, *Da Costa*	v r	r	r
—— sulcata, var. elliptica	f	..	f
—— compressa, var. striata	..	..	v r
—— borealis, *Chemnitz*	c	r	a
Venus lincta, *Pulteney*	..	..	v r
—— chione, *L.*	..	..	r
—— casina, *L.*	..	..	v r
—— gallina, *L.*	..	..	f
Tapes virgineus, *L.*	..	..	v r
Tellina balthica, *L.* (T. solidula, *Pult.*)	a	a	v a
—— calcaria (T. proxima, *Brown*)	..	..	f
Psammobia ferröensis, *Ch.*	f	r	f
Mactra solida, *L.*	r	r	..
—— solida, var. elliptica	..	..	c
—— subtruncata, *Da C.*	v r	..	v r
Lutraria elliptica, *Lamarck*	v r		
Scrobicularia alba, *Wood*	v r		
Thracia pubescens, *Pult*	..	..	v r
Corbula gibba, *Olivi* (C. nucleus, *Lam.*)	..	..	v r
Mya truncata, *L.*	f	r	c
Saxicava rugosa, *L.*	..	..	r
—— rugosa, var. arctica	..	..	r
Pholas candida, *L.*	r		
—— crispata, *L.*	..	..	v r
Dentalium entalis, *L.*	..	..	f
—— striolatum, *Stimpson* (D. abyssorum, *Sars*)	..	v r	f
Trochus cinerarius, *L.*	..	r	
Lacuna divaricata, *Fabricius*	f	..	r
Littorina obtusata, *L.*	..	..	v r
—— rudis, *Maton*	..	..	f
—— litorea, *L.*	f	..	c
Homalogyra atomus, *Philippi*	..	..	v r
Turritella terebra, *L.*	a	a	v a
Scalaria communis, *Lam.*	..	..	v r
Odostomia interstincta, *Mont.*	..	..	v r
Natica sordida, *Ph.*	..	..	v r
—— catena, *Da C.*	..	v r	
—— Alderi, *Forbes*	..	..	v r
—— affinis, *Gmelin* (N. clausa, *Broderip & Ponsonby*)	r	..	v r

LIST OF MOLLUSCA, &c.—*con.*

	Lower Boulder Clay, Dawpool.	Middle Sands and Gravels, Upton.	Upper Boulder Clay, Newton-by-Chester.
Admete viridula, *Fabricius*	..	..	v r
Aporrhais pes-pelecani, *L.*	r	r	v r
Purpura lapillus, *L*	f	f	f
Buccinum undatum, *L.*	f	f	f
Murex erinaceus, *L.*	f	f	f
Trophon clathratus, *L.*, var. truncata	f	r	c
Fusus antiquus, *L.*	r	..	v r
—— despectus, *L.*	v r		
Nassa reticulata, *L.*	r	f	r
—— incrassata, *Ström*	r		
Pleurotoma rufa, *Mont.*	..	..	v r
—— turricula, *Mont.*	r	..	f
—— Trevelyana, *Turton*	r		
—— pyramidalis, *St.*	..	..	f
Cypræa europæa, *Mont.*	..	..	v r
POLYZOA.			
Salicornaria Cuvieri, *Lam.*	v r	..	r
Lepralia Peachii, *Johnston*	..	..	v r
For Ostracoda see separate list for those found at Newton and Dawpool.			
CIRRIPEDIA.			
Balanus crenatus, *Brug.*	r	..	v r
—— sulcatus, *Lam.*	..	..	v r
ANNELIDA.			
Serpula vermicularis, *Ellis*	..	..	v r
Spirorbis nautiloides, *Lam.*	r	..	r
ECHINOIDEA.			
Cidaridæ, spines of, from the sand within Gastropoda	f	..	f
Spatangidæ, spines of, from the sand within Gastropoda	f	..	f
Toxopneustes dröbachiensis, *Müll.*	..	..	v r
SPONGIDA.			
Cliona, sp., in shells	r	r	r
Grantia, sp., spicula of, from the sand within Gastropoda	f	..	f
For Foraminifera see separate list of those found at Newton and Dawpool.			

List of Diatomaceæ found in Chester and District, and Cwm Bychan, N.W.

BY DR. H. STOLTERFOTH, M.A.

Read December 3rd, 1874.

THE following list formed the groundwork of a Paper read before the Society, December 3rd, 1874. A large number of Diatomaceous gatherings had then been made in the immediate neighbourhood of Chester. An Estuary like that of the river Dee presents good collecting ground, and the surface-net has been used on the Estuary with good results on fine bright days. The high elevations in North Wales have also given many of the forms peculiar to such habitats, and there are abundance of ditches in which fresh-water forms may be found. The extensive marshes of Frodsham, Helsby, &c., have yielded good specimens. Surfaces of rocks, in which the district abounds, subjected to drippings from water, often present the well-known olive green, rich in Diatoms, and these have, in most cases, been carefully examined. The method of collecting and preserving Diatoms has been so often described that I need not enter on this subject.

All the forms mentioned in the following list have been found in the district worked by the Chester Society of Natural Science, with one exception—that is, the Fossil Diatomaceæ of the Lake Cwm Bychan. I have, however, included this (17) for the reason that it is the only fossil bed of Diatoms known in N. Wales; and also because this earth was mentioned by WM. SMITH, in his "Synopsis of British Diatomaceæ," as

Dolgelly earth. Cwm Bychan is, however, fifteen miles from Dolgelly. I do not offer anything new in the way of classification, but have followed that of PROF. KUTZING, as given in Pritchard's "Infusoria." In all that relates to the identification of species I have followed WM. SMITH'S "Synopsis of British Diatomaceæ," and have always found his figures most reliable. I have used abbreviations for the authority of the Genus and Species, which will be easily recognised by those who study the subject. I cannot pretend that this list is exhaustive, since I have only entered those names of which I was certain. The number of synonyms, under which some of the forms are known, has made no little confusion, and I have therefore been careful not to increase this difficulty.

The number before the Species marks the slide in the Cabinet of the Society; in the last column v r (*very rare*) signifies that the form has only been found in one gathering; r (*rare*), found in two gatherings; c (*common*), found in three gatherings; v c (*very common*), found in four or more gatherings.

The *locality* given is generally that in which the form was first recognised, although it may occur abundantly in other gatherings.

The *date* given is that when the collection was made.

FAMILY I.—EUNOTIEÆ.

No.	NAME.	LOCALITY.	OCCURRENCE.
	EPITHEMIA, *Kutz.*		
39	alpestris, *Sm.*	Heron Bridge Rocks	Dec. '73......r
22	Argus, *Sm.*	Llangollen	Aug. '72.....r
5	constricta, *n. sp.*	Mostyn	July '71 ..v c
10	gibba, *Kutz.*	Helsby Marsh	March '72..v c
18	Hyndmanii, *Sm.*	Parkgate	June '72...v r
22	longicornis, *Ehr.*	Llangollen	Aug. '72...v r
58	proboscoidea, *Kutz.*	Cemetery Pond, Chester	May '71....v r
17	rupestris, *n. sp.*	Cwm Bychan deposit	..........v r
39	sorex, *Kutz*	Heron Bridge Rocks	Dec. '73....v r
13	turgida, *Sm.*	Frodsham Marsh	March '72..v c
39	ventricosa, *Kutz*	Heron Bridge Rocks	Dec. '73....v r
24	zebra, *Kutz*	Combermere	March '73..v r

This genus is well represented. The only form that I have found out of place is *Hyndmanii*, but as only a few valves appeared in the brackish water of Parkgate I cannot suppose that it grew there, but had been washed down from its place of growth in the fresh water.

Family I.—EUNOTIEÆ—*con.*

No.	Name.	Locality.	Occurrence.
	Eunotia, *Ehr.*		
3	arcus, *Sm.*	Queen's Park, Chester	May '71 ....r
55	gracilis, *n. sp.*	Storeton Quarry	July '76 ..v r
17	tetraodon, *Ehr.*	Cwm Bychan deposit	..............r
	Himantidium, *Ehr.*		
17	arcus, *Sm.*	Cwm Bychan deposit	.... v r
17	bidens, *Ehr*	Cwm Bychan deposit	..............r
6	pectinale, *Kutz.*	Canal, Chester	Sept. '71...v c
17	undulatum	Cwm Bychan deposit	.... v r

FAMILY II.—MERIDIEÆ.

	Meridion, *Ag.*		
8	circulare, *Ag.*	Heron Br. Rock, Chester..	March '72..v c
56	constrictum, *Ralfs*	Heron Br. Rock, Chester..	Feb. '72......r

FAMILY III.—LICMOPHOREÆ.

	Rhipidophora, *Kutz.*		
57	elongatum, *Kutz.*	Rhyl	July '73 ...v r
	Podosphenia, *Ehr.*		
..	gracilis	Mostyn	Oct. '77 ...v r

FAMILY IV.—FRAGILARIEÆ.

	Denticula, *Kutz.*		
59	obtusa, *Kutz.*	Wepre Brook	Aug. '72...v r
22	sinuata, *n. sp*	Llangollen	Aug. '72...v r
	Odontidium, *Kutz.*		
37	Harrisonii, *n. sp.*	Mostyn	July '75 ...v r
22	mesodon, *Kutz.*	Llangollen	Aug. '72.....c
24	mutabile, *n. sp.*	Combermere	March '73...c
39	tabellaria, *n. sp.*	Heron Br. Rock, Chester..	Dec. '73...v r
	Fragilaria, *Lyngb.*		
9	capucina, *Kutz.*	Lache Lane, Chester	March '72..v c
39	virescens, *Ralfs*	Heron Bridge	Dec. '73...v r

FAMILY IV.—FRAGILARIEÆ—*con.*

No.	NAME.	LOCALITY.	OCCURRENCE.
	DIATOMA, *Dec.*		
9	elongatum, *Ag.*	Lache Lane, Chester	March '72..v c
60	grande, *n. sp.*.......	Mostyn	July '72....v r
3	vulgare, *Bory*......	Queen's Park	May, '71 ..v c
	ASTERIONELLA, *Hass.*		
27	Bleakleyii	Estuary of Dee..........	April '74 ...v r
27	Ralfsii	Estuary of Dee..........	April '74 ...v r

Both these last forms were got in the tow-net very abundantly, and having burnt them on the thin glass I have preserved them in their natural state. *Bleakleyii* is not very perfectly siliceous, and on this account it is difficult to figure or describe except in the fresh state.

	NITZSCHIA, *Hass.*		
2	acicularis, *Sm.*	Flookersbrook, Chester ..	May '71....v c
3	amphioxys, *Sm.* ..	Queen's Park, Chester ..	May '71....v c
7	bilobata, *Sm.*......	Queen's Ferry	Dec. '71 .....r
32	birostrata, *Sm.*	Mostyn	July '74....v r
22	Brebissonii, *Sm*....	Llangollen	Aug. '72.....c
29	closterium, *Sm.*	Ince Marsh	May '74....v r
9	curvula, *Kutz.*......	Lache Lane, Chester	March '72....c
2	dubia, *Sm.*	Flookersbrook	May '71....v c
20	lanceolata, *Sm.*	Mostyn	July '75....v r
1	linearis, *Sm.*	Heron Bridge	April '71...v c
9	minutissima, *Sm.* ..	Lache Lane, Chester	March '72..v r
10	obtusa, *n. sp.*	Helsby Marsh	March '72..v r
56	parvula, *n. sp.*	Heron Bridge	Feb. '72....v c
45	palea, *Kutz.*........	Handbridge	Nov. '71 c
29	plana, *Sm.*	Ince Marsh	May '74....v r
5	sigma, *Sm.*........	Mostyn	July '71 ....v c
2	sigmoidea, *Sm.*	Flookersbrook	May '71....v c
20	scalaris, *Sm.*	Holywell	May '75....v r
15	tænia, *Sm.*	Connah's Quay	May '72....v c
30	virgata	Colwyn	July '74....v r
4	vivax, *n. sp.*	Heron Bridge	May '71....v r
30	distans, *n. sp.*	Colwyn	July '74....v r
	AMPHIPLEURA, *Kutz.*		
22	pellucida	Llangollen	Aug. '72 ...v c

FAMILY V.—SURIRELLEÆ.

	BACILLARIA, *Gmel.*		
5	paradoxa, *Gmel.*....	Mostyn	July '71....v c
	HOMÆOCLADIA, *Ag.*		
20	sigmoidea, *n. sp.* ..	Queen's Ferry	Dec. '71....v r

FAMILY V.—SURIRELLEÆ—*con.*

No.	NAME.	LOCALITY.	OCCURRENCE.
	SYNEDRA, *Ehr.*		
60	acicularis, *Sm.*	Mostyn	July '72....v r
19	affinis, *Kutz.*	Hilbre Island	July '72....v c
12	arcus, *Kutz.*........	Helsby Marsh	March '72..v c
24	biceps, *Sm.*	Combermere	March '73....r
53	flexuosa, *Breb.*	Rhydymwyn	Sept. '74....v r
10	fulgens, *Sm.*	Helsby Marsh	March '72....r
23	Gallioni, *Ehr.*......	Rhyl	Sept. '72 ...v r
3	gracilis, *Kutz.*	Queen's Park	May '71....v c
9	hamata, *n. sp.*......	Lache Lane	March '72..v r
3	lunaris, *Ehr.*	Queen's Park	May '71 ....v c
3	minutissima, *Kutz.*..	,, ,, ...	,, ,, ...v c
54	obtusa, *Sm.*...	Helsby Marsh	March '75 ...c
3	pulchella, *Kutz.*	Queen's Park	May '71....v c
9	radians, *Sm.*	Lache Lane	March '72..v c
6	tabellaria, *Kutz*	Canal, Chester	Sept. '71...v c
22	ulna, *Ehr.*	Llangollen..............	Aug. '72...v c
..	Vaucherii	Cym Bychan deposit	Aug. '77 ...v r
	RHAPHONEIS, *Ehr.*		
15	Amphiceros, *Ehr.* ..	Connah's Quay	May '72....v c
	TRYBLIONELLA, *Sm.*		
1	acuminata, *n. sp.* ..	Heron Bridge	April '71...v c
54	gracilis, *n. sp.*	Helsby Marsh	March '75..v r
21	granulata, *n. sp.*....	Mostyn	July '71....v r
2	marginata, *n. sp.*....	Flookersbrook	May '71....v c
60	punctata, *n. sp.*	Mostyn	July '72....v r
1	scutellum, *Sm.*	Heron Bridge	April '71 ..v c
	CYMATOPLEURA, *Sm.*		
1	apiculata, *n. sp.*	Heron Bridge	April '71...v r
22	elliptica, *Sm.*	Llangollen	Aug. '72...v c
2	Solea, *Sm.*	Flookersbrook	May '71....v c
	SURIRELLA, *Turp.*		
17	biseriata, *Breb.*	Cwm Bychan deposit	.... v r
3	Brightwellii, *Sm*....	Queen's Park	May '71....v c
46	craticula, *Ehr.*	Railway Station	Nov. '71 ....r
10	crumena, *Breb.*	Helsby Marsh	March '72....r
5	gemma, *Ehr.*	Mostyn	July '71....v c
2	linearis, *n. sp.*	Flookersbrook	May '71....v c
65	minuta, *Breb.*......	Chester	June '71 .....r
17	nobilis, *n. sp.*......	Cwm Bychan deposit	.............r
2	ovalis, *Breb.*	Flookersbrook	May '71....v c
10	ovata, *Kutz.*........	Helsby Marsh	March '72..v c
45	pinnata, *n. sp.*	Handbridge	Nov. '71.....r
51	salina, *Sm.*	Railway Bridge	April '73...v c
10	splendida, *Kutz.*....	Helsby Marsh	March '72....r
5	striatula, *Turp.*	Mostyn	July '71....v c

I have retained *craticula* in this genus, but I have little doubt that it belongs to the genus *Navicula,* and is a sporangial form. In a pure gathering of *Navicula ambigua* I found it sparingly scattered, three or four valves on each slide. On comparing the external forms they appear to me to be almost identical, and the fine striæ of the *Naviculæ* are much the same as those in *craticula*.

FAMILY V.—SURIRELLEÆ—*con.*

No.	NAME.	LOCALITY.	OCCURRENCE.
	CAMPYLODISCUS, *Ehr.*		
38	bicostatus, *Sm.*	Mostyn	July '75....v r
53	costatus	Rhydymwyn	Sept. '74.....r
38	cribrosus	Mostyn	July '75....v r
1	spiralis	Heron Bridge	April '71 c

The persistence with which some species occupy the same position is well seen in *spiralis*. Year after year I have found this form on the Heron Bridge Rock, sometimes in abundance, but never wholly absent.

FAMILY VI.—STRIATELLEÆ.

	TETRACYCLUS, *Ralfs.*		
17	lacustre, *Ralfs*......	Cwm Bychan deposit	.... v r
	TABELLARIA, *Ehr.*		
24	fenestrata, *Kutz.*....	Combermere	March '73 ....r
24	flocculosa, *Kutz.*....	Combermere	March '73..v c
	STRIATELLA, *Kutz.*	NOT REPRESENTED.	
	RHABDONEMA, *Kutz.*		
52	arcuatum, *Kutz.*	Holywell	Sept. '73....v r
19	minutum	Hilbre Island............	July '72....v r
	GRAMMATOPHORA, *Ehr.*		
30	marina, *Kutz.*......	Colwyn	July '74 .....r

FAMILY VII.—MELOSIREÆ.

	CYCLOTELLA, *Kutz.*		
3	antiqua, *n. sp.*	Queen's Park	May '71....v r
3	Kutzingiana, *Thw.*..	Queen's Park	May '71......c
2	operculata, *Kutz.* ..	Flookersbrook	May '71......c
24	rotula, *Kutz*	Combermere	March '73..v r
21	Scotica, *Kutz*.......	Mostyn	July '72 c
	HYALODISCUS, *Ehr.*		
14	lævis, *Ehr.*	Connah's Quay..........	May '72 ....v r

Family VII.—MELOSIREÆ—*con.*

No.	Name.	Locality.	Occurrence.
	Podosira, *Ehr.*		
36	maculata, *Sm.*......	Estuary of Dee..........	July '75 .....r
	Melosira, *Ag.*		
22	arenaria, *Sm.*	Llangollen	Aug. '72 .....r
5	marina, *Sm.*.........	Mostyn	July '71....v r
23	moniliformis, *Kutz.*.	Rhyl	Sept. '72.....r
11	nummuloides, *Kutz.*	Helsby Marsh	March '72..v c
8	nivalis, *Sm.*........	Heron Bridge............	March '72..v r
17	orichalceæ, *Sm.*	Cwm Bychan deposit	............v r
17	punctata, *n. sp.*	Cwm Bychan deposit	c
2	subflexilis, *Kutz.*...	Flookersbrook	May '71....v r
2	varians, *Ag.*........	Flookersbrook	May '71....v c
15	Westii, *Sm.*.........	Connah's Quay..........	May '72....v r

FAMILY VIII.—COSCINODISCEÆ.

	Coscinodiscus, *Ehr.*		
18	concinnus, *Sm.*	Parkgate	June '72.....r
18	eccentricus, *Ehr.* ..	Parkgate	June '72....v c
14	radiatus, *Ehr.*......	Connah's Quay..........	March '72..v r
	Odontodiscus, *Ehr.*		
61	eccentricus	Estuary of Dee..........	June '72 ...v r
	Actinocyclus, *Ehr.*		
18	Ralfsii, *Sm.*.........	Parkgate	June '72....v r
7	undulatus, *Kutz.*....	Queen's Ferry...........	Dec. '71 ....v c

FAMILY IX.—EUPODISCEÆ.

	Eupodiscus, *Ehr.*		
14	Argus, *Ehr.*.........	Connah's Quay..........	May '72....v r
	Costodiscus,		
5	Johnsonianum, *n. sp.*	Mostyn	July '71. ..v r

FAMILY X.—BIDDULPHIEÆ.

	Biddulphia, *Gray.*		
15	aurita, *Breb.*	Connah's Quay	May '72....v c
14	Baileyi, *Sm.*.........	Connah's Quay	May '72....v c
16	obtusa, *Kutz.*	Connah's Quay	May '72....v r
18	radiatus, *n. sp.*	Parkgate	June '72....v r
18	rhombus, *Sm.*	Parkgate	June '72..... r
18	turgida, *Sm.*	Parkgate	June '72....v r

FAMILY XI.—ANGULIFEREÆ.

No.	Name.	Locality.	Occurrence.
	TRICERATIUM, *Ehr.*		
27	Brightwelli, *West* ..	Estuary of Dee..........	April '74 ..v r
15	favus, *Ehr.*	Connah's Quay	May '72......r
36	striolatus, *Ehr.*	Estuary of Dee..........	July '75....v r

FAMILY XII.—TERPSINOEÆ.

UNREPRESENTED.

FAMILY XIII.—CHÆTOCEROS.

No.	Name.	Locality.	Occurrence.
	CHÆTOCEROS, *Ehr.*		
27	armatum, *West*	Estuary of Dee	April '74...v r
15	boreale, *Bail.*	Connah's Quay..........	May '72....v r
	ATHEYA, *West.*		
27	decora, *West*	Estuary of Dee..........	April '74...v r
	RHIZOSOLENIA, *Ehr.*		
15	setigera, *Bri.*	Connah's Quay..........	May '72......r
15	styliformis, *Bri.*	Connah's Quay..........	May '72....v r

FAMILY XIV.—COCCONEIDEÆ.

No.	Name.	Locality.	Occurrence.
	COCCONEIS, *Ehr.*		
17	pediculus, *Ehr.*	Cwm Bychan deposit	............v c
2	placentula, *Ehr*	Flookersbrook	May '71....v c
19	scutellum, *Ehr.*	Hilbre Island	July '72 ...v r
25	Thwaitesii	Heron Bridge	April '73...v r

FAMILY XV.—ACHNANTHEÆ.

No.	Name.	Locality.	Occurrence.
	ACHNANTHIDIUM, *Kutz.*		
25	coarctatum, *Breb.* ..	Heron Bridge	April '73...v c
3	lanceolatum, *Breb.*..	Queen's Park..........	May '71....v c
26	lineare, *Sm.*........	Ceiriog River	June '73....v r
	ACHNANTHES, *Bory.*		
26	exilis, *Kutz.*........	Ceiriog River	June '73...v r
21	longipes, *Ag.*	Hoylake	July '77....v c
28	subsessilis, *Sm.*	Ince Marsh	May '74....v r

FAMILY XVI.—CYMBELLEÆ.

No.	Name.	Locality.	Occurrence.
	CYMBELLA, *Ag.*		
8	cuspidata, *Kutz*....	Heron Bridge..........	March '72....r
24	Ehrenbergii, *Kutz*..	Combermere	March '73..v r
5	Scotica, *Sm.*.......	Mostyn	July '71....v r

Family XVI.—CYMBELLEÆ—*con.*

No.	Name.	Locality.	Occurrence.
	Cocconema, *Ehr.*		
24	cistula, *Ehr.*	Combermere	March '73..v c
22	cymbiforme, *Ehr.* ..	Llangollen	Aug. '72.....r
22	lanceolatum, *Ehr.* ..	Llangollen	Aug. '72...v c
	Encyonema, *Kutz.*		
24	cæspitosum, *Kutz* ..	Combermere	March '73..v r
3	prostratum, *Ralfs* ..	Queen's Park	May '71....v c
	Amphora, *Ehr.*		
7	affinis, *Kutz.*	Queen's Ferry...........	Dec. '71.....c
29	binodis, *Greg.*......	Ince Marsh	May '74....v r
43	hyalina, *Kutz.*......	Mostyn	July '75....v c
43	complexa, *Greg.*....	Mostyn	July '75....v r
29	lævis, *Greg*	Ince Marsh.............	May '74....v r
41	littoralis, *Dn.*	Rhyl..................	July '73....v r
52	membranacea, *Sm* ..	Holywell	Sept. '73...v r
54	minutissima, *n. sp.*.	Helsby Marsh	March '75..v r
47	Normani, *n. sp.*.....	Mollington	Dec. '71....v r
2	ovalis, *Kutz.*	Flookersbrook...........	May '71....v c
5	paludosa, *n. sp.*	Mostyn	July '71......r
16	salina, *Sm.*	Connah's Quay..........	May '72 c
5	spectabilis, *Greg*....	Mostyn	July '71......r
29	ventricosa, *Greg*....	Ince Marsh.............	May '74....v r

FAMILY XVII.—GOMPHONEMEÆ.

No.	Name.	Locality.	Occurrence.
	Gomphonema, *Ag.*		
3	acuminatum, *Ehr.* ..	Queen's Park	May '71....v c
9	capitatum, *Ehr.*	Lache Lane	March '72....c
13	constrictum, *Ehr.* ..	Frodsham Marsh	March '72..v c
6	curvatum, *Kutz.*....	Canal, Chester...........	Sept. 71.....v c
2	dichotomum, *Kutz.*.	Flookersbrook	May '71....v c
26	geminatum, *Ag.*....	Ceiriog River...........	June '73 ...v c
17	intricatum, *Kutz.* ...	Cwm Bychan deposit....	...........v r
59	marinum, *Sm.*......	Wepre Brook...........	Aug. 72......c
1	tenellum, *Sm.*......	Heron Bridge	April '71 c
22	vibrio, *Ehr.*........	Llangollen..............	Aug. '72....v r

FAMILY XVIII.—NAVICULEÆ.

No.	Name.	Locality.	Occurrence.
	Navicula, *Dn.*		
61	abrupta, *Greg.*	Estuary of Dee..........	June '72 ...v r
17	acuta, *Kutz.*	Cwm Bychan deposit	c
30	æstiva, *Dn.*	Colwyn	July '74....v c
10	affinis, *Ehr.*........	Helsby Marsh	March '72 ....r
40	alpina, *Sm.*	Bala	July '76....v r
1	amphirhyncus, *Ehr.*	Heron Bridge	April '71....c
46	ambigua, *Ehr.*	Railway Station.........	Nov. '71......r

FAMILY XVIII.—NAVICULEÆ—*con.*

No.	NAME.	LOCALITY.	OCCURRENCE.
	NAVICULA—*con.*		
2	amphisbæna, *Bory* ..	Flookersbrook...........	May '71....v c
24	Anglica, *Ralfs*	Combermere.............	March '73..v c
46	apiculata, *Breb*.....	Railway Station	Nov. '71.....r
..	apis, *Ehr*...........	Queen's Park	May '71....v r
30	aspera, *Ehr.*	Colwyn	July '74....v r
66	binodis, *Ehr.*	Chester	March '71..v r
21	bombus, *Ehr.*	Mostyn	July '75....v r
40	Borealis, *Ehr*......	Bala	July '76......r
60	Carassius, *Ehr.*	Mostyn	July '72....v r
30	Clepsydra, *Dn.*	Colwyn	July '74....v r
3	cocconeiformis, *Greg*	Queen's Park............	May '71....v r
15	crabro, *Ehr.*	Connah's Quay..........	May '72....v r
9	crassinervis, *Breb* ..	Lache Lane.............	March '72....r
..	crucicula, *Sm.*	*Vide* Stauroneis.	
2	cryptocephala, *Kutz.*	Flookersbrook	May '71....v c
2	cuspidata, *Ehr.*	,, ,, ...	,, ,, ...v c
21	Cyprinus, *Ehr.*	Mostyn	July '75....v r
56	dicephala, *Ehr.*	Heron Bridge............	Feb. '72 .....r
62	didyma, *Ehr.*	Bagillt	May '72....v r
58	directa, *Sm*.........	Cemetery Pond	May '71....v r
9	dirhyncus, *Ehr.*	Lache Lane	March '72..v c
11	distans, *Sm.*	Helsby Marsh	March '72..v r
17	divergens, *n. sp.*....	Cwm Bychan deposit....	...........v r
3	dubia, *Ehr*.........	Queen's Park............	May '71....v r
11	elegans, *Sm.*	Helsby Marsh	March '72....r
1	elliptica, *Kutz.*	Heron Bridge	April '71...v c
1	firma, *Kutz.*	,, ,, ...	,, ,, ...v c
63	fortis, *Greg*........	Mostyn	July '75....v r
5	fusca, *Greg*	Mostyn..................	July '71....v r
1	gibberula, *Kutz.* ..	Heron Bridge............	April '71....c
46	gracillima, *Greg.* ..	Railway Station	Nov. '71.....c
21	granulata, *Breb.* ...	Rhyl	July '73....v r
1	humerosa, *Kutz*....	Heron Bridge	April '71...v r
65	inflata, *Kutz.*	Chester.................	June '71....v r
5	interrupta, *Kutz.* ..	Mostyn	July '71....v c
24	irridis, *Kutz.*	Combermere	March '73..v c
5	Jennerii, *Sm.*.......	Mostyn	July '71....v c
30	Johnsonii, *n. sp.*....	Colwyn	July '74....v r
4	lævissima, *Kutz.*....	Heron Bridge	May '71......c
30	littoralis, *Dn.*	Colwyn	July '74....v r
61	lyra, *Ehr.*	Estuary of Dee..........	June '72....v r
17	major, *Kutz*........	Cwm Bychan deposit	.............r
14	marina, *Ralfs*......	Connah's Quay..........	May '72......c
30	maxima, *Greg.*	Colwyn	July '74....v r
24	mesolepta, *Ehr.*....	Combermere	March '73..v r
7	minutula, *n. sp.*....	Queen's Ferry	Dec. '71 c
3	musca, *Greg.*	Queen's Park	May '71....v r
24	nobilis, *Greg*	Combermere	March '73..v r
30	Northumbrica, *Dn.*.	Colwyn	July '74....v r
21	numerosa, *Dn.*	Hoylake	July '77... v r

FAMILY XVIII.—NAVICULEÆ—*con.*

No.	NAME.	LOCALITY.	OCCURRENCE.
	NAVICULA—*con.*		
6	oblonga, *Kutz.*	Canal, Chester	Sept. '71.....r
17	ovalis, *Dn.*	Cwm Bychan deposit	...........v c
14	palpebralis, *Breb.*	Connah's Quay	May '72......c
5	peregrina, *Dn.*	Mostyn	July '71....v c
2	producta, *n. sp.*	Flookersbrook	May '71....v r
14	pusilla, *Sm.*	Connah's Quay	May '72....v c
5	pygmæa, *Kutz.*	Mostyn	July '71....v c
64	radians, *Sm.*	Rhydymwyn	May '72......r
17	radiosa, *Sm.*	Cwm Bychan deposit	...........v c
30	rectangulata, *Greg.*	Colwyn	July '74....v r
17	rhomboides, *Ehr.*	Cwm Bychan deposit	.............r
20	rostrata, *Ehr.*	Mostyn	July '72....v r
3	rhynchocephala, *Kutz*	Queen's Park	May '71....v c
15	semiplena, *Greg.*	Connah's Quay	May '72....v r
46	sphærophora, *Kutz.*	Railway Station	Nov. '71 ...v c
44	staureiformis, *Sm.*	Canal, Chester	Nov. '75 .....r
5	suborbicularis, *Greg.*	Mostyn	July '71....v r
11	subsalina, *Dn*	Helsby Marsh	March '72..v c
7	varians, *Greg.*	Queen's Ferry	Dec. '71......r
48	venata, *Kutz.*	Cop	March '72....c
1	viridis, *Sm.*	Heron Bridge	April '71...v c
7	Westii, *n. sp.*	Queen's Ferry	Dec. '71....v c

In this large genus *Navicula* I have attempted no arrangement, but have placed the species in alphabetical order. I have included the genus *Pinnularia*, as in their general form and growth they resemble the *Naviculæ;* and it is only in their markings that a difference is perceptible.

I have obtained considerable help in the identification of species from the three parts published of DR. DONKINS' "Natural History of British Diatomaceæ," and which treated of the genus *Navicula.*

	STAURONEIS, *Ehr.*		
7	acuta, *n. sp.*	Queen's Ferry	Dec. '71....v r
2	anceps, *Ehr.*	Flookersbrook	May '71....v c
11	crucicula, *n. sp.*	Helsby Marsh	March '72..v c
7	gracilis, *Ehr.*	Queen's Ferry	Dec. '71....v c
1	phænicenteron, *Ehr.*	Heron Bridge	April '71 c
24	punctata, *Kutz.*	Combermere	March '73..v r
18	pulchella, *n. sp.*	Parkgate	June '72....v r
14	salina, *n. sp.*	Connah's Quay	May '72......r
	PLEUROSIGMA, *Sm.*		
42	acuminatum, *Sm.*	Bangor	Aug. '74...v c

Family XVIII.—NAVICULEÆ—*con.*

No.	Name.	Locality.	Occurrence.
	Pleurosigma—*con.*		
5	angulatum, *Sm.*	Mostyn	July '71....v c
6	attenuatum, *Sm.*	Canal, Chester	Sept. '71...v c
16	balticum, *Sm*	Connah's Quay	May '72....v c
54	delicatulum, *Sm.*	Helsby Marsh	March '75....c
15	distortum, *Sm.*	Connah's Quay	May '72 c
5	elongatum, *Sm*	Mostyn	July '71......c
5	fasciola, *Sm.*	,,	,, ,, ...v c
42	formosum, *Sm.*	Bangor	Aug. '74 ...v r
14	hippocampus, *Sm*	Connah's Quay	May '72....v c
2	lacustre, *Sm.*	Flookersbrook	May '71....v c
5	littorale, *Sm*	Mostyn	July '71......r
41	marinum, *Sm*	Rhyl	July '73...,v r
43	prolongatum, *Sm.*	Mostyn	July '75......c
14	obscurum, *Sm.*	Connah's Quay	May '72 .....r
7	scalprum, *Sm*	Queen's Ferry	Dec. '71....v r
9	Spencerii, *Sm*	Lache Lane	March '72..v c
42	strigilis, *Sm.*	Bangor	Aug. '74.....r
31	strigosum, *Sm.*	Mostyn	July '74....v r
30	tenuissimum, *n. sp.*	Colwyn	July '74 .....r
	Toxonidia, *Dn.*		
34	Gregoriana, *Dn.*	Connah's Quay	May '75......r
36	insignis, *Dn.*	Estuary of Dee	July '75....v r

These last two forms I have never found abundant about Chester; only a few valves of *Gregoriana* on the tidal mud; and *insignis* I have only taken in the tow-net on the Estuary of the Dee.

	Amphiprora, *Ehr.*		
5	alata, *Kutz*	Mostyn	July '71....v c
41	littoralis	Rhyl	July '73....v r
5	paludosa, *n. sp.*	Mostyn	July '71 c
21	vitrea, *n. sp.*	Hoylake	July '77 ..v r
41	plicata, *n. sp.*	Rhyl	July '73....v r
42	pusilla, *n. sp.*	Bangor	Ang. '74....v r

SUB-FAMILY.—SCHIZONEMA.

	Mastogloia, *Thw.*		
5	Smithii, *Thw.*	Mostyn	July '71......r
35	lanceolata, *Thw.*	Puddington Marsh	June '75.....r
	Dickeia, *Berk & Ralfs*		
30	ulvoides, *Berk.*	Colwyn	July '74....v r

SUB-FAMILY—SCHIZONEMA—*con.*

No.	NAME.	LOCALITY.	OCCURRENCE.
	COLLETONEMA, *Breb.*		
43	eximium, *Thw.*	Mostyn	July '75......c
9	neglectum, *Thw.* ...	Lache Lane	March '72..v c
49	vulgare, *Thw.*......	Helsby Marsh	March '72 ....r
	SCHIZONEMA, *Ag.*		
11	cruciger, *n. sp.*	Helsby Marsh	March '72 ...r
12	helmintosum, *Greg.*.	Helsby Marsh	March '72..v r
35	obtusum, *Chauv.* ...	Puddington Marsh	June '75....v r

FAMILY XIX.—ACTINISCEÆ.

	DICTYOCHA, *Lam.*		
36	Gracilis, *Ehr.*	Estuary of Dee..........	July '75....v r

It is doubtful if this form is a Diatom. I should have placed it with the *Radiolaria* if it had not been for the fact that, when found in the fresh state, it is always composed of two valves, which enclose a space.

DOUBTFUL GENUS.

	EUCAMPIA, *Ehr.*		
14	Zodiacus, *Ehr.*......	Connah's Quay..........	May '72......r

I have placed this beautiful form last in the list on account of our present ignorance as to its exact position amongst the Diatomaceæ. In some respects it ought to be near *Biddulphia* or perhaps *Meridion.* Its nearest affinity however, to my mind, is in the beautiful genus *Corinna,* found in the Jutland deposit, and which has been described by HEIBERG. *Eucampia* was found on the surface of the Estuary of the Dee, in 1872, in such abundance, that on taking up a glassful of water the forms gave the water quite a greenish tinge. It was again found abundantly in 1875, but it does not seem always present, and perhaps weather and sunshine may partly account for this fact. In a fresh state the form presents the appearance of a complete corkscrew with many turns, and may be seen revolving when exposed to the light. This wonderful movement I had the pleasure of witnessing with CHARLES KINGSLEY at CAPTAIN BUSH's house, when we had a fresh gathering under the microscope.

As a matter of history I may here state that our Society, in 1872, was only just established, and wanting a device for its seal; this lovely specimen, found in our Dee, seemed most appropriate; and encircling, as it does, the monogram of our first President, it constitutes a fitting and perpetual memorial of his presence amongst us. But we must go further back than 1872 if we would do honour to the discoverer of *Eucampia.* We have amongst us one who has been through life a minute and industrious observer in the fields of Nature, and it was in one of MR. JOHN PRICE's note-books, dating back as far as 1843, that the *Eucampia* was figured as found by him, with other objects of interest, in the Estuary of the Mersey. This was twenty-nine years before it was again found in the Dee, and eleven years before W. SMITH figured and described it in his "Synopsis of British Diatomaceæ"; and then he had only seen the *Eucampia* as taken from the stomach of a *Pecten.*

NOTE.—*n. sp. indicates that the species were new at the time of the publication of "Smith's British Diatomaceæ" and "Gregory's Diatomaceæ of the Clyde," but being now well established they ought to be accredited to* Sm. *and* Greg.

The Foraminifera of the River Dee.

BY J. D. SIDDALL.

THE results proposed to be offered in the following Catalogue have been attained from the examination of the Microzoa of the Estuary of the river Dee. Material for the purpose has been collected from all parts of the river from Chester to the Sea, principally by scraping the sand near low-water mark, but also by means of the tow-net and dredge. The richest and most productive gatherings of Foraminifera have been made at the following points, viz. :—Chester, from the sandbank opposite the old cheese-stage; Saltney, from the sandbanks opposite the wharf, and also immediately below the next bend of the river; Holywell, from the pools on the shore near high-water mark; and Hilbre Island, from among the rocks between the Little Eye and Middle Island. Sand collected at intermediate places either by scraping or dredging, was not nearly so rich as any of these four, either in point of the number of shells in it, or in the variety of species. Living specimens have been obtained from Burton Marsh, Holywell, and Hilbre Island. These may always be got by carefully scraping the surface of the velvety brownish mud at the bottom of the pools left by the tide, or by skimming the top of the water if this mud be found to have risen, as it sometimes will, under the influence of light, &c. This oozy mud should then be washed through a fine muslin net, to get rid of the impalpable part of it, and the residuum collected into small bottles, which should be kept uncorked in a cool place out of direct sunlight, when the Foraminifera will creep up the sides of the bottles, and will live there for many months. From thence they are readily picked off with a fine-pointed camel's hair pencil, and transferred to a slide or cell for microscopic examination. The species most commonly found living are *Polystomella striato-punctata*, *Nonionina depressula*, and *Gromia oviformis;* and frequently associated with these are *Difflugia pyriformis* and *D. aculeata.* Specimens are thus readily obtainable for studying the life-history of both the Imperforate and Perforate divisions of the group, and also the Amœbina.

Foraminifera of various species are brought up the river in the frothy scum which floats with the tide, but no living specimen has ever been obtained from this source; those so found being dead and dry shells which have been picked up from the sand-banks by the "bore" of the tide, and carried towards Chester along with it. Surface gatherings from the lower parts of the river abound with large and heavy forms of Diatomaceæ, the exuviæ of Crustacea, and swimming Entomostraca, but contain no Foraminifera. Mr. Shepheard, Mr. A. O. Walker, and Dr. Stolterfoth have also diligently used the tow-net hereabouts, but the only living Foraminifer I have either seen or heard of from this source was a small *Textularia variabilis,* obtained by the last-named gentleman, although bottom dredgings from the same localities yield Foraminifera abundantly.

In a very rich gathering of Rhizopoda, made at Holywell on the 19th of April, 1875, all the above-mentioned species were very plentiful; and some fine living specimens of *Polystomella striato-punctata* then obtained were afterwards kept under observation for several days. They were for a few days particularly active, and crawled about the cells in which they were placed for examination. At the end of that time, the pseudopodia of some became finally retracted, and the sarcode showed a tendency to become granulated and condensed into an oval mass in the centre of each chamber of the shell. The following note, having reference to this aggregation of the sarcode, was made at the time:—" . . . Twelve chambers of shell were visible externally. The granular oval contents of chambers

Nos. 2, 4, and 9 (from the aperture) were furnished with cilia, distinctly apparent with a power of 400 diameters, and swam freely about in the chambers; on the contents of the other chambers no cilia were visible, and the form assumed by the contracted sarcode was not so definite. Colour of sarcode brownish yellow; moving bodies rather more dense, and therefore very slightly darker in colour." The cilia were very plain; and the writer was corroborated in his observation by the REV. J. L. BEDFORD, F.L.S., who was present at the time.

This formation of ciliated spheroids of sarcode within the chambers of the parent shell, no doubt represented the earliest stages of one kind of reproduction of the species, and the probability is, that on the breaking up of the shell the spheroids would be liberated, and live for some time in the free swimming condition; then absorb their cilia, settle down, and secrete a shell, and become the primordial chamber of a form like the parent.

The old river "silt" has also been examined superficially from Sealand, from the Roodee near the Dee Stands and City Walls, the Groves near the Suspension Bridge, and Deva Terrace. This "silt" was collected from depths of three to six feet below the surface during the recent drainage operations. It was in most places distinctly laminated, and had every appearance of having been deposited by the river before it was confined to the present channel. That from the Roodee was obtained from *below* the thin peaty band upon which Roman remains were found so plentifully, and, in common with all the other gatherings, was found to contain large quantities of Foraminifera, which, taken as a whole, appeared to differ very slightly from freshly gathered specimens from the lower parts of the river. A list of these sub-recent Foraminifera would be very interesting for comparison with that appended below, and for this reason:— it is well known that the degree of salinity of the water has a marked effect upon them; larger and better grown shells are now obtained from Holywell and Hilbre than Chester or Saltney. Before Sealand and the Roodee were reclaimed, a much larger quantity of tidal water must have reached Chester, and this would tend to make the Chester forms then as fine and well grown as those from Hilbre are now. So far as was seen this seemed to be the case, but the comparison was not carried far enough to place it beyond doubt.

The subjoined catalogue has been arranged in accordance with Dr. Carpenter's "Introduction to the Study of the Foraminifera." The debated question whether *Gromia* should or should not be included amongst Foraminifera is not of much moment in the present case.

Some of the forms contained in the list are new to the British fauna, or otherwise possess points of considerable interest, and the following notes respecting them may be acceptable :—

Gromia oviformis, and *Gr. Dujardini.*

Gromia oviformis, Dujardin, 1835, Ann. des Sci. Nat., Sec. 2, vol. iii., p. 313; and vol. iv., p. 345, pl. 9, fig. 1.

Gromia Dujardinii, Max Schulze, 1854, Ueber den Organ. Polythal., p. 55, pl. 7, fig. 1—7.

Among collections of living Dee Foraminifera, *Gromia* is always largely represented, but its test is very rare indeed among shells obtained by the usual process of drying and floating from sand. This is owing to the great tenuity and delicacy of the test, which is little more than membranous, and does not possess sufficient strength to support its own weight. When living specimens are allowed to dry upon a slide, their tests collapse, and either assume hemispherical or scale-like forms, or become shapeless masses, each one surrounded by a glistening ring of dried sarcode.

Cornuspira involvens, Reuss.

Operculina involvens, Reuss, 1849, Denkschr. Akad. Wien., vol. i., p. 370, pl. xlv., fig. 20.

Cornuspira involvens, Jones, Parker, and Brady, 1865, Monog. Crag Foram. p. 3, pl. iii., figs. 52-54.

Messrs. Jones, Parker, and Brady *(loc. cit.)* admit Professor Reuss's name for the thicker *Cornuspiræ* with rounded tube, as distinct from the outspread flattened contour of *C. foliacea.* Probably the real zoological significance of the character is not great; but it seems quite worth recognizing.

**Quinqueloculina tenuis*, Czjzek.

Quinqueloculina tenuis, Czjzek, in Haidinger's Abhandl. Wiss., vol. ii., p. 149, pl. xiii., figs. 31-34.

Miliola (Quinqueloculina) tenuis, Parker and Jones, North Atlantic and Arctic Foram., p. 411, pl. xvii., fig. 84.

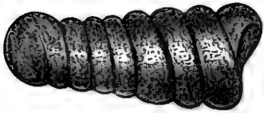
An extreme enfeeblement of *Q. seminulum*, Spiroloculine in aspect, and twisted on itself. Several small specimens of this have been found by Mrs. Shone in the Dee, but it is more at home in the deeper waters of the Mediterranean and other Seas. It also occurs fossil in the Lias Clay of Stockton, Warwickshire.

Trochammina Shoneana, n. sp., fig. 1, 2.

Characters.—Test spiral, subcylindrical, slightly tapering, narrow end rounded; composed of a single series of close convolutions of a non-septate tube on a linear axis. Sutural line more or less depressed externally. Aperture large, rounded, formed of the end of the tube, somewhat constricted. Texture finely arenaceous; colour light brown to rusty red. Length $\frac{1}{100}$th to $\frac{1}{80}$th inch.

Fig. 1.

Fig. 2.



This form is closely allied to *Trochammina gordialis*, and *Tr. charoides.* It differs from the former in its elongate regular habit of growth, and from the latter in the extension of the convolutions lengthwise in single series, instead of their superposition in several layers.

The very few specimens which have been found by Mrs. Shone and myself, have all been obtained from Hilbre or Holywell, and, finding that it is new to science, I have, with her permission, named it after my valued friend and co-worker.

° *Trochammina charoides*, Parker and Jones.

Trochammina squamata charoides, Parker and Jones, Quart. Jour. Geol. Soc., 1860, vol. xvi., p. 304.

Trochammina charoides, Carpenter, Introduction to Foram., 1862, p. 141, pl. xi., fig. 3.

So named from the resemblance of the test to the "nucule" of *Chara*.

Lituola findens, Parker.

Lituola findens, Parker, (in G. M. Dawson's paper) Canadian Naturalist, N.S., vol. v., p. 176, wood-cut, fig. 1.

Typical examples of this are twice or thrice forked, but in the Dee we seldom find it with more than a simple column of five to eight chambers, which, in outward appearance, closely resembles the uni-serial portion of *Bigenerina digitata*, and, being generally found broken, it is just possible that the fragments which have led to the placing of the latter name on the list, may belong to the above.

Haliphysema Tumanowiczii, Bowerbank.

Haliphysema Tumanowiczii, Bowerbank, Brit. Spong., vol. i., pl. xxx., fig. 359.

Squamulina scopula, Carter, 1870, Ann. and Mag. Nat. Hist., Ser. 4, vol. v., p. 309, pl. 4 and 5.

Originally described by Dr. Bowerbank as "the smallest of British Sponges," the true rhizopodal nature of this has recently been demonstrated by Mr. Saville Kent, who has seen the pseudopodia extended in specimens from the Channel. The first example from the Dee was dredged at the mouth of the river by A. O. Walker, Esq., F.L.S. It is fixed upon *Quinqueloculina subrotunda*, and was entangled among the roots of *Cellularia avicularia*.

* *Lagena aspera*, Reuss.

Lagena aspera, Reuss, 1861, Sitzungsb. d. k. Akad. Wiss. Wien., vol. xl., p. 305, pl. i., fig. 5.

A rare species, with superficial rugosity caused by small, short, blunt spines. Well figured by Professor Reuss from fossil Tertiary specimens, but not figured in any English work.

Lagena trigono-marginata, Parker and Jones.

Lagena trigono-marginata, Parker and Jones, 1865, Phil. Trans., vol. clv., p. 419, pl. 48, fig. 1 a. b.

L. marginata, *L. ornata*, and *L. lucida*, all occur in the trigonal condition in the Dee, the latter form being the most frequent. Messrs. Parker and Jones figure the first-named in the supplementary plates of their Monograph of North Atlantic and Arctic Foraminifera. Their specimens were from the Eocene beds of Grignon, in France, but some of the trifacial and trimarginate forms have been met with by Mr. D. Robertson, F.G.S., on the coast of Durham, and by Mr. Jos. Wright, F.G.S., on the North coast of Ireland. These varieties were first noticed, by Seguenza, in the Miocene marls of Messina, who described six "species" from this source, under the distinct generic name *Trigonulina*.

Polymorphina Thouini, D'Orbigny.

Polymorphina Thouini, D'Orbigny, 1826, Ann. Sci. Nat., vol. ii., p. 265, No. 8, Modéle No. 23; Brady, Parker, and Jones, 1870, Trans. Linn. Soc., Lond., vol. xxvii., p. 232, pl. xl., fig. 17.

An interesting and exceedingly well-marked variety, of which one very beautiful specimen was obtained. It has an attenuated subcylindrical contour, with long, upright, compactly fitting segments.

* *Polymorphina spinosa*, D'Orbigny.

Globulina spinosa, D'Orbigny, 1846, For. Foss., Vien., p. 203, pl. xiii., figs. 23, 24.

Polymorphina spinosa, Brady, Parker, and Jones, 1870, Trans. Linn. Soc., Lond., vol. xxvii., part 2, p. 243, pl. xlii., figs. 36 a. b.

A solitary specimen of this extremely rare shell, the surface of which is studded with short stout spines, was found by MRS. SHONE. Hitherto it had only been known as a Miocene fossil from the south of Europe.

⁕ *Sphæroidina bulloides*, D'Orbigny.

Sphæroidina bulloides, D'Orbigny, 1826, Ann. Sci. Nat., vol. vii., p. 267, No. 1, Modéles No. 65.

Sphæroidina Austriaca, Reuss, 1850, Deukschr. Akad. Wein., vol. i., pl. 51.

Sphæroidina bulloides, Parker and Jones, 1864, North Atlantic and Arctic Foram., p. 369, pl. xvi., fig. 52.

A deep water form, allied to *Globigerina*, very small and rare in the Dee.

Pullenia sphæroides, D'Orbigny.

Nonionina sphæroides, D'Orbigny, 1826, Ann. Sci. Nat., vol. vii., p. 293, No. 1, Modéle No. 43.

Pullenia sphæroides, Parker and Jones, 1864, North Atlantic and Arctic Foram., pl. xiv., figs. 43, a b, and xvii., fig. 53.

A neat little shell resembling *Nonionina*, but more nearly allied to *Globigerina;* one of the rarest Dee forms, but probably occasionally overlooked through its minute size.

Bulimina squamigera, D'Orbigny.

Bulimina squamigera, D'Orbigny, 1839, Foram. Canaries, p. 137, pl. 1, fig. 22-24.

A single specimen has been found of an elongate, subcylindrical *Bulimina*, slightly flattened on three sides, with flush sutures and rounded extremities, which, but for its characteristic aperture, might have passed for a *Clavulina*. It answers fairly well to D'Orbigny's figures of *Bulimina squamigera*, to which species, pending the discovery of further examples, it may perhaps be assigned.

Spirillina tuberculata, Brady.

This is a manuscript species, concerning which MR. BRADY has forwarded me the following particulars:—

"CHARACTERS.—Test, free, discoidal, spiral; consisting of a non-"septate tube coiled on itself in one plane. Upper and lower surfaces flat "or very slightly concave, studded with minute tubercles; exterior "presenting little or no trace of the course of the spiral tube; periphery "square. Colour white. Diameter $\frac{1}{50}$ inch.

"This form, which is perhaps a strongly developed variety of *Spirillina* "*margaritifera*, was first obtained from deep water off Eddystone, and has "been since found by MR. ROBERTSON on other parts of our coast."

A few specimens have been found in the Dee which come nearer to this than to any other known form, but differ from it in having only the lower surface tuberculate, while the upper surface has the spiral sutural line strongly limbate, and the shell perforations numerous and well marked.

Discorbina biconcava, Parker and Jones.

Parker and Jones, 1865, North Atlantic and Arctic Foram., p. 422, pl. xix., fig. 10 a b c.

A square-edged, bi-concave form, easily distinguished from the other *Discorbinæ*, but very feeble and rare in the Dee.

Tinoporus lucidus, Brady, MS.

Tinoporus lucidus, Brady, 1870, Cat. Brit. Foram. in the Edinburgh Museum, p. 8. (No description.)

This is by no means an uncommon form, and MR. BRADY'S manuscript name has been generally adopted by British rhizopodists. It was originally described in a paper on the "Rhizopodal Fauna of the Hebrides," at the meeting of the British Association in 1866, the author then regarding it as a species of *Polytrema*, a genus in which it might be placed with almost equal justice, but in the doubt which still existed as to its affinity, the description did not appear in the abstract of the paper. Somewhat later, the same organism was figured by MR. PARFITT as a Polyzoan (*Cellepora hemisphærica*, Ann. and Mag. Nat. Hist., 1873, 4 Ser., vol. xii., p. 98, pl. 3 b, fig. 1-6), a position to which it has no claim. In the absence of any published details, the following characters will serve to identify the species:—The test is normally adherent, and, when young somewhat resembles that of *Planorbulina mediterranensis.* At a later stage it either spreads laterally over the surface of the body on which it is growing, or piles its little inflated chambers one upon the other in acervuline fashion, until the mass assumes a nearly hemispherical contour. It is tolerably common on the West coast of Ireland, and has been found by Mr. Brady, Mr. Robertson, and the Rev. A. M. Norman, in dredgings off the shores of Scotland and elsewhere. The loose specimens obtained from Hilbre and the lower parts of the Dee estuary, are generally somewhat rolled and abraded, as though they had been washed in by the tide, but I have also found it growing upon a Sertularian.

All the species contained in this list have, with characteristic kindness, been carefully revised and authenticated by H. B. Brady, Esq., F.R.S. Those to which an asterisk is prefixed have been collected by Mrs. Elizabeth Shone, whose persevering study has been rewarded by the discovery of several species new to the British seas. Some of the forms enumerated are only represented by one or two depauperated, broken, or unsatisfactory specimens, and it is very desirable that future observers should verify the occurrence of the shells marked "very rare."

Sub-Kingdom, PROTOZOA.

Class, RHIZOPODA.

1. Order, RADIOLARIA—Actinophryna, Acanthometrina, Polycystina, Thalassicollina.
2. Order, LOBOSA—Amœbina.
3. Order, RETICULARIA—Foraminifera.

ORDER—FORAMINIFERA.

SUB-ORDER—IMPERFORATA.

1. FAMILY—GROMIDA.

TYPICAL SPECIES.	GENERA, SPECIES, AND VARIETIES.	REMARKS.
	GROMIA, *Duj.*	
	Dujardini	rare.
	oviformis	frequent.

2. FAMILY—MILIOLIDA.

TYPICAL SPECIES.	GENERA, SPECIES, AND VARIETIES.	REMARKS.
Cornuspira foliacea, *Phil.*	CORNUSPIRA, *Schultze*	
	involvens, *Reuss*	rare, new to Britain.
Miliola seminulum, *Linn.*	BILOCULINA, *D'Orb.*	
	ringens, *Lamk*	very rare.
	elongata, *D'Orb.*	frequent.
	depressa, *D'Orb.*	,,
	TRILOCULINA, *D'Orb.*	
	oblonga, *Montagu*	,,
	tricarinata, *D'Orb.*	very rare.
	trigonula, *D'Orb*	rare.
	*Brongniartii, *D'Orb.*	very rare.
	QUINQUELOCULINA, *D'Orb.*	
	agglutinans, *D'Orb.*	rare.
	seminulum, *Linn.*	frequent.
	*tenuis, *Czjzek.*	very rare.
	pulchella, *D'Orb.*	rare.
	bicornis, *W. & J.*	frequent.
	secans, *D'Orb.*	rare.
	subrotunda, *Montagu*	abundant.
	Ferussaccii, *D'Orb.*	very rare.
	Candeina, *D'Orb.*	,,
	fusca, *Brady*	rare.
	SPIROLOCULINA, *D'Orb.*	
	planulata, *Lamk.*	,,
	canaliculata, *D'Orb.*	,,
	limbata, *D'Orb.*	,,
	excavata, *D'Orb*	,,

3. Family—LITUOLIDA.

Typical Species.	Genera, Species, and Varieties.	Remarks.
Trochammina squamata, *P. & J.*	Trochammina, *P. & J.*	
	incerta, *D'Orb.*	rare.
	Shoneana, *n. sp*	very rare.
	gordialis, *P. & J.*	,,
	*charoides, *J. & P.*	,,
	squamata, *P. & J.*	rare.
	macrescens, *Brady*	,,
	inflata, *Montagu*	frequent.
Lituola nautiloidea, *Lamk.*	Lituola, *Lamk.*	
	canariensis, *D'Orb*	,,
	findens, *Parker*	rare; new to Britain.
	scorpiurus, *Montf.*	,,
	fusiformis, *Will.*	,,
	globigeriniformis, *P. & J.*	,,
Haliphysema Tumanowiczii *Bow.*	Haliphysema, *Bowerbank.*	
	Tumanowiczii, *Bow.*	very rare.

Sub-Order—PERFORATA.

1. Family—LAGENIDA.

Lagena sulcata, *W. & J.*	Lagena, *W. & J.*	
	sulcata, *W. & J.*	frequent.
	Lyelli, *Seguenza*	rare.
	lævis, *Montagu*	frequent.
	gracillima, *Seguenza*	very rare.
	striata, *D'Orb*	rare.
	gracilis, *Will.*	very rare.
	semistriata, *Will*	frequent.
	globosa, *Montagu*	,,
	marginata, *W. & J*	,,
	trigono-marginata, *P. & J.*	very rare.
	ornata, *Will.*	rare; also trigonal.
	pulchella, *Brady*	very rare.
	lucida, *Will*	frequent; also trigonal.
	*aspera, *Reuss.*	new to Britain.
	caudata, *D'Orb.*	rare.
	melo, *D'Orb.*	frequent.
	squamosa, *Montagu*	,,
	*striato-punctata, *P. & J.*	very rare.
	*distoma, *P. & J.*	,,
	*Jeffreysii, *Brady*	,,
Nodosaria raphanus, *Linn.*	Nodosaria, *Lamk.*	
	scalaris, *Batsch*	rare.
	radicula, *Linn.*	very rare.
	Dentalina, *D'Orb.*	
	guttifera, *D'Orb*	rare.
	obliqua, *D'Orb.*	,,
	communis, *D'Orb.*	frequent.

1. FAMILY--LAGENIDA—*continued.*

TYPICAL SPECIES.	GENERA, SPECIES, AND VARIETIES.	REMARKS.
Nodosaria raphanus, *Linn.*	VAGINULINA, *D'Orb*	
	*legumen, *Linn.*	very rare; fragment.
	MARGINULINA, *D'Orb.*	
	raphanus, *D'Orb*	very rare.
	glabra, *D'Orb*	,,
	CRISTELLARIA, *Lamk.*	
	rotulata, *Lamk.*	rare.
	italica, *Defrance*	very rare.
	crepidula, *F. & M.*	frequent.
Polymorphina lactea, *W. & J.*	POLYMORPHINA, *D'Orb.*	
	communis, *D'Orb.*	,,
	compressa, *D'Orb.*	,,
	oblonga, *Will.*	,,
	Thouini, *D'Orb.*	v r; new to Britain.
	*spinosa, *D'Orb*	,, ,,
	*Orbignii. *Zborzewski*	very rare.
	fusiformis, *Roemer*	,,
	lactea, *W. & J.*	frequent.
	concava, *Will*	rare.
	gibba, *D'Orb.*	frequent.
	var. æqualis, *D'Orb.*	,,
Uvigerina pygmæa, *D'Orb.*	UVIGERINA, *D'Orb.*	
	angulosa, *Will.*	,,
	pygmæa, *D'Orb.*	,,
	*irregularis, *Brady*	,,

2, FAMILY—GLOBIGERINIDA.

Orbulina universa, *D'Orb.*	ORBULINA, *D'Orb.*	
	universa, *D'Orb.*	rare.
Globigerina bulloides, *D'Orb.*	GLOBIGERINA, *D'Orb.*	
	bulloides, *D'Orb.*	frequent.
Sphæroidina bulloides, *D'Orb.*	*SPHÆROIDINA, *D'Orb.*	
	bulloides, *D'Orb.*	very rare.
Pullenia sphæroides, *D'Orb.*	PULLENIA, *P. & J.*	
	sphæroides, *D'Orb*	,,
Textularia agglutinans, *D'Orb.*	TEXTULARIA, *Defrance*	
	sagittula, *Defrance*	rare.
	variabilis, *Will.*	frequent.
	pygmæa, *D'Orb.*	rare.
	difformis, *Will.*	,,
	agglutinans, *D'Orb*	,,
	VERNEUILINA, *D'Orb.*	
	polystropha, *Reuss*	,,
	spinulosa, *Reuss*	very rare.

2. Family—GLOBIGERINIDA—*continued.*

Typical Species.	Genera, Species, and Varieties	Remarks
Bulimina Presli, *Reuss.*	Bulimina, *D'Orb.*	
	pupoides, *D'Orb.*	frequent.
	marginata, *D'Orb.*	„
	aculeata, *D'Orb.*	very rare.
	squamigera, *D' Orb.*	„
	ovata, *D'Orb.*	frequent.
	elegantissima. *D'Orb.*	rare.
	Virgulina, *D'Orb.*	
	Schreibersii, *Czjzek*	very rare.
	Bolivina, *D'Orb.*	
	punctata, *D'Orb.*	rare.
	plicata, *D'Orb.*	frequent.
	costata, *D'Orb.*	rare.
	Bigenerina, *D'Orb.*	
	digitata, *D'Orb.*	doubtful; broken.
Spirillina vivipara, *Ehrenb.*	Spirillina, *Ehrenberg*	
	margaritifera, *Will.*	rare.
	vivipara, *Ehrenberg*	„
	tuberculata, *Brady*	doubtful.
Cassidulina lævigata, *D'Orb.*	Cassidulina, *D'Orb.*	
	lævigata, *D'Orb.*	rare.
	crassa, *D'Orb.*	„
Discorbina turbo, *D'Orb.*	Discorbina, *P. & J.*	
	rosacea, *D'Orb.*	frequent.
	globularis, *D'Orb.*	„
	ochracea, *Will.*	rare.
	Bertheloti, *D'Orb.*	very rare.
	*biconcava, *P. & J.*	„
Planorbulina farcta, *F. & M.*	Planorbulina, *D'Orb.*	
	Mediterranensis, *D'Orb.*	frequent.
	Haidingerii, *D'Orb.*	rare.
	*Ungeriana, *D' Orb*	„
	Truncatulina, *D'Orb.*	
	lobatula, *Walker*	abundant.
	refulgens, *Montfort*	very rare.
Pulvinulina repanda, *F. & M.*	Pulvinulina, *P. & J.*	
	repanda, *F. & M.*	very rare.
	Canariensis, *D'Orb*	rare.
	auricula, *F. & M.*	„
Rotalia Beccarii, *Linn.*	Rotalia, *Lamk.*	
	Beccarii, *Linn*	abundant.
	nitida, *Will*	rare.
Tinoporus vesicularis, *P. & J.*	Tinoporus, *Montfort*	
	lucidus, *Brady*	very rare.
Patellina concava, *Lamk.*	Patellina, *Will.*	
	corrugata, *Will.*	rare.

3. FAMILY—NUMMULINIDA.

TYPICAL SPECIES.	GENERA, SPECIES, AND VARIETIES.	REMARKS.
Polystomella crispa, *Linn.*	POLYSTOMELLA, *Lamk.*	
	crispa, *Linn*................	rare.
	striato-punctata, *F.* & *M*.....	abundant.
	NONIONINA, *D'Orb.*	
	scapha, *F.* & *M*............	rare.
	depressula, *W.* & *J.*	abundant.
	umbilicatula, *Montf*........	rare.
	turgida, *Will.*	,,
	asterizans, *F.* & *M*..........	,,
	*stelligera, *D'Orb*............	,,

Note from a Paper on the Microscopic Life of the Mountain Limestone.

Read December, 1877.

BY G. W. SHRUBSOLE, F.G.S.

SACCAMMINA CARTERI (Brady) was first found by MASTER W. SHEPHEARD in road-metal near Chester, and was recognised and named by MR. SIDDALL. In a visit to the Quarry of the Minera Lime Company, with MR. SIDDALL, the author observed a band of black limestone, two or three feet in thickness, entirely made up of the above-mentioned Foraminifer, and containing less than 1 per cent. of matter insoluble in acid. This bed occurs near the base of the Carboniferous Limestone.

Fresh Water Polyzoa found in the Neighbourhood of Chester.

BY T. SHEPHEARD.

HAVING been requested by the Committee to publish my notes on the Fresh-Water Polyzoa found in this district, I feel that, owing to my engrossing business occupation, the record must necessarily be of a fragmentary character; it may, however, such as it is, induce younger members, who have more leisure than myself, to give their attention to this most delightful branch of Natural Science.

Cristatella mucedo, Cuvier.

Specific character.—Cœnœcium sacciform, hyaline, with a common flattened disc adapted for locomotion; orifices placed on the surface opposite to the disc, and arranged in several concentric marginal series. Statoblasts orbicular, with an annulus and marginal spines.—*Allman.*

This, the Queen of Polyzoa, was first found in this locality in the Lake in Oulton Park Gardens, on the 22nd July, 1874. It had then only two Polypides, one considerably larger than the other. On the 2nd of August the same colony contained four Polypides, which appeared in great beauty, the first being still the largest.

On the 13th and 20th September, 1874, I found several full-grown specimens in the Canal, near the Mollington Road Bridge; and on the 4th October found others, which were wasting, and being devoured by worms, &c. The Statoblasts were, at this time, very numerous and beautiful, and plainly seen through the transparent skin of the animal. On the 29th October, when the animal was completely destroyed, the Statoblasts collected into an oval sac, which floated on the surface of the water. This I observed in a specimen placed in my own aquarium, thus showing that when the animal has performed the functions assigned to it, it dies, leaving the Statoblasts to continue the species.

I have no record of it for 1875.

On the 7th and 19th August, 1876, some very fine specimens were found in the same place by MR. MANNING.

It was carefully searched for in 1877, but could not be found. Its disappearance I attribute to the removal of the weeds from the Canal Bank.

In September, 1878, two colonies only were found near Backford Bridge.

Lophopus crystallinus, Pallas.

Specific character.—Cœnœcium sacciform, hyaline, with a disc which serves for attachment but not for locomotion; ectocyst gelatinoid; orifices scattered. Statoblasts elliptical, with an annulus, but without marginal spines.—*Allman.*

This was the first of the fresh-water Polyzoa found in this locality. It was discovered by DR. STOLTERFOTH in January, 1872, in a ditch running from Queen's Park to the river. The specimens were very large and beautiful, and being the first seen here, they created intense interest. The same ditch has been diligently searched every year since, without success.

Another habitat, however, has yielded a rich supply. It is a pond on the north of the Lache Lane, in which they were first found on 2nd March, 1876, and were then very fine; and also in April; but at the end of May I searched for them in vain. On the 29th December of the same year, I found a few very young specimens, and in February, 1877, they were larger; but at the latter end of March and early in April they were very fine and fully developed. On the 24th May I found them in the same pond, floating on the surface quite detached from the weeds, and a few were also found attached. I also found some in a pond on the south of the same lane. I searched for them late in July, but could not find any; MR. WILKINS, however, found one or two small colonies a few days later. but they were very scarce. On the 3rd March, 1878, I found some good sized colonies in the first-named pond.

It would seem, from these observations, that the *Lophopus* is more a winter and spring form than the other species, which are most abundant in the summer and autumn.

On the 21st February, 1878, a colony of four had developed from Statoblasts placed in a glass dish last summer; these, on the 1st of March, had increased to twelve or thirteen, thus showing an increase of one per day.

As quoted above, DR. ALLMAN notes that the Cœnœcium of Lophopus serves for attachment, but *not* for locomotion; I have, however, on several occasions, observed a *very* considerable change in the position of colonies placed in glass cells for examination.

Alcyonella fungosa, Pallas.

Specific character.—Cœnœcium fungoid, formed of numerous branched vertical tubes destitute of a furrow. Statoblasts broad.—*Allman.*

This form was looked for owing to the Statoblasts having been previously seen floating on a pond in the Town Lane, Wrexham Road.

It was found on the 3rd of August, 1876, and again on the 29th September, when the colonies were full of Statoblasts, and the animal showing signs of decay.

Some young colonies, which resembled *fungosa* more than the other species, were found near Haughmond Abbey, on the 26th June, 1877.

MR. JAS. ROWLAND found some fine colonies in a pond on Delamere Forest, early in October, 1878, which were exhibited at the Conversazione of our Society.

Alcyonella Benedeni, Allman.

Specific character.—Cœnœcium fungoid; formed of numerous branched vertical tubes, which are emarginate at the orifice, and furnished with a furrow.—(Free) Statoblasts elongated.—*Allman.*

This well-marked species was found attached to twigs in a mill dam at Cold Higham, Northamptonshire, on the 18th July, 1876, in company with *A. fungosa;* and the latter was also found in the same place in August, 1877.

The rarity of *A. Benedeni* must be my apology for inserting a form not found in our district; only one locality for it being recorded by Prof. Allman, viz. :—Chelmar Canal, Essex.

Plumatella repens, Linnæus.

Specific character.—Cœnœcium irregularly branched, cells sub-claviform, destitute of furrow and keel. Tentacula about sixty; margin of calyx distinctly festooned. Statoblasts broad.—*Allman.*

Found 9th June, 1874, in the Serpentine, Curzon Park; on the 27th August, 1876, in Canal, near Stone Bridge; and also in Canal, near Water Works, 29th April, 1877; in Canal, near Tarvin Road Bridge, and also in Canal, near Mollington Road Bridge, on 26th August, with *Fredericella sultana.*

Plumatella Dumortieri, Allman.

Specific character.—Cœnœcium adherent, irregularly branched; cells somewhat dilated towards the orifices, with a furrow carinated. Tentacula about fifty; festooning of calyx deep and distinct. Statoblasts broad.—*Allman.*

Our late and lamented friend, Mr. Cross, found this at Ashton Hayes, in a pond belonging to Mr. Parr, on the 19th June, 1875.

There was a difference of opinion about this species; some of our members thought it *P. repens,* but the specimens I saw certainly agreed with Prof. Allman's description of *Dumortieri.* It had a very peculiar flickering or pulsating motion in its tentacles, which I have not observed in any other species.

Prof. Allman gives one locality *only* for this species,—viz., Crix, Essex.

Fredericella sultana, Blumenbach.

Specific character.—Cœnœcium confervoid, composed of a membrano-corneous branched tube, with the branches distinct from one another and terminated by the orifices. Lophophore nearly circular ; tentacular crown campanulate. Statoblasts bean-shaped, destitute of annulus and spines. —*Allman.*

This was first found in this district on 21st June, 1872, in the Canal near the College; and on 13th and 20th September, 1874, it was very plentiful in the Canal, near Backford; but on the 4th November, very few were alive. Some of the tubes, with Statoblasts, placed in my aquarium, began to develop on the 11th February, 1875, and on the 3rd March some more hatched, and on the 6th they had grown considerably.

Found some *very young* forms in the Canal on 25th March in the same year, attached to young Spongilla, which seemed to thrive well together, and both were very interesting and beautiful.

On the 18th March, 1877, found several very young forms, none of them with more than two, and some with only one Polypide, from which a bud was seen growing near the top of the Polypidom.

The latter end of April the *Fredericella* was abundant. The opening of the Statoblast is very curious, and resembles that of a bivalve-shell, from which the animal protrudes and soon forms a tube, and grows rapidly into a colony by budding.

This species is the most abundant of all, and is found in the Canal close to Chester, and for a considerable distance on either side of it.

Paludicella Ehrenbergi, Van Beneden.

Specific character.—Cœnœcium membrano-corneous, branched; branches composed of a series of claviform cells placed end to end and separated from one another by complete septa; orifices tubular, lateral, placed near the wide extremity of each cell. Lophophore orbicular, no epistome or calyx. Statoblasts not observed.—*Allman.*

This was first found in this locality on the 29th of April, 1877, near the Canal Locks, next beyond Tarvin Road Bridge. It was afterwards found in the same place in May and August, in company with *Cordylophora lacustris* and a host of microscopic organisms. I again found it there early in March this year (1878) when it had the appearance described (as below) by VAN BENEDEN, but which PROF. ALLMAN had not witnessed in any specimens found in Great Britain.

"VAN BENEDEN thus describes the occurrence of '*hybernacula*' or *gemmæ*, which, under the influence of a favourable temperature, would have grown into the ordinary lateral branches of the Polyzoon, but which, towards the commencement of winter, acquire a conical form, and then become for a while arrested in their development. In this state they remain until the following spring, when the investing membrane splits to allow of the elongation of the branch."

No Statoblasts having been observed in *Paludicella*, it appears highly probable that their place is supplied by the Hybernacula, thus described by VAN BENEDEN.

Late in October, 1878, I found some living colonies of this species in the Canal, near to Backford Bridge.

If *Cristatella* is (as it deserves to be called) the Queen of Polyzoa, this form, as an infant in comparison, although quite unlike it in form, may with propriety be named The Princess, as, from its coy shyness, its delicacy of texture, its beauty of form, its quick playful habits, and its well-marked distinction from all the other species, entitle it, I think, to the second rank. Those only who have patience to thoroughly watch its habits, can at all appreciate its beauty and loveliness. PROF. ALLMAN well describes it as an exceedingly timid little animal, and a specimen may be for hours under observation before the polypides will venture to issue from their cells, and then it is often for only a few seconds at a time that they will continue visible.

Those who may take an interest in this branch of Natural History, will find all the species here named, with many others, beautifully described and illustrated by PROF. ALLMAN, in his "Monograph of the Fresh-Water Polyzoa," published by the *Ray Society*.

"Proliferous Leaves, and Notes thereon."

BY J. PRICE, M.A.

MR. PRICE has, at different times, brought forward the subject of the leaf-germination of that very common plant *Cardamine pratensis,* (Meadow-cress, Lady-smock, May-flower, &c.,) and has exhibited specimens in various stages of development. We may refer our readers to the article "Proliferous leaves" in "OLD PRICE'S REMAINS" p. 347, and to several contributions, by him, to the Liverpool Naturalists' Magazine, or Scrap-book, or both, now unhappily extinct. The principal phenomena observed are as follows :—

1. The leaves are, in the strictest sense, "compound," the leaflets being attached to the common petiole by very loose joints, so that they are very easily detached, and often cover your hand, like wafers, when taking up the plant. Frost, or burial in the soil, separates them without at all diminishing their vitality.

2. Each leaflet, however small, and whether attached or detached, is apt to germinate under favorable circumstances, such as submergence, moisture, and shade (but often without these) all through the Winter, which is the period of their greatest activity. The terminal leaflet often produces several plants. The lateral ones have not yet been observed to do so. Little plants issue, more rarely, from the petiole at the junctures of the folioles; and axillary sprouts on the stem itself.

3. The process is, however, greatly aided and accelerated by artificial means; by keeping them on wet surfaces in a warm room, covered up in damp moss or in a bottle, which, when carried in the pocket has twice at least induced the secondary plants to commence germinating, and thus exhibited three generations at once: twelve little plants were exhibited on a single *terminal* leaflet at the British Association, and much admired by PROF. BALFOUR; since which time eighteen if not nineteen were raised by making ten transverse sections of a very large leaflet, which were successfully dried and exhibited at our Conversazione, 1875.

4. As to the process, the radicle first appears on the upper side of the leaflet as a silver thread, and the plumule commences as a tubercle, enclosed in a green vesicle which soon bursts like an eggshell. This is always on the median line, at the very base of the leaflet, and may or may not be followed by a series along the mid rib and other ribs; but *never* on the margin, as in Bryophyllum, though the ribs certainly do extend to the very edge. PROF. BALFOUR said it seemed as if every cell were capable of development, when he saw a leaf bristling with little germs. It is however very desirable that microscopists should examine the leaflets *previous to germination*, and ascertain whether the peripheral cells, which are never proliferous, differ sensibly from the rest, and especially from the basal which are always fertile. The history of "the cell" is not yet quite exhausted.

5. No other British Plant has been induced by any coaxing or nursing, to act the part which this Cardamine performs, unaided, in all weathers except hard frost. Rootlets are given out freely by Watercress; and whole plants spring from submerged *stems* of *Ranunculus flammula*, and some others. Proliferous grasses and garlics are common; and we know the habit of one of the *Polygonums*, hence called *viviparum*. These, however, are all apart from the reproductive function of our leaf, *pur et simple*, without the slightest metamorphosis. Certain exotics as *Pelargonium*, *Gloxinia*, and *Begonia*, are raised, in

stoves under glass, from leaf-sections planted edgewise into select soil; but in some of these a bulb is first developed, as in *Dentaria bulbifera.*

Mr. Price has repeatedly tried exotic leaves and leaflets which exhibited the above character of loose jointing, as if to prepare for a separate existence; but quite in vain. And the leaves of other cresses, though hardly distinguishable from *Cardamine pratensis,* resist all attempts at instruction in the proliferous art. Mr. Price not having registered a right of patent in the Cuckoo flower business, wishes to share the profits with junior partners to any amount: and earnestly invites their best exertions for the following purposes:—

a. To try various ways of promoting this secondary reproduction, besides floating, submersion, wet blotting paper or linen, bottling, and burying; both in the folioles, petioles, and stems.

b. To ascertain the limit of reproduction in terminal and lateral folioles; the smallest size and earliest age capable of this process; the greatest number of quasi-seedlings and of actual seedlings from any single plant of *Cardamine pratensis.*

c. To persevere in experimenting on a great variety of hopeful or *hopeless* subjects in this and other genera, carefully watching the *margin* of their leaves.

d. To compare, from a teleological point of view, the relative frequency of this plant and of others *not* provided with this extra mode of multiplication; and to ascertain whether there be any hindrances to the ripening of its seeds or any *extra* causes of their destruction.

It is to be observed that these germs, excepting the primary one at the base, are in no sense even apparently axillary. Nor do they (as in *Bryophyllum*) spring, ready made, "just where the seeds would be attached if the leaf were folded into a capsule." The leaf proper, or rather minute portions of it (perhaps a single cell of the *parenchyma* or the woody fibre) "shows itself adequate to every function of stamen and pistil" without the ordinary special metamorphosis. The enquiry into the "*natura naturans*" of such cells, *previous to movement;* into the "*latens processus*" as it does commence; into the character of the little bladder above noticed; and into other collateral phenomena, is now left, by the observer of "some submerged and half-decayėd leaves in a ditch near Upper Bebington in the winter of 1849," as a legacy to his younger followers along the footsteps of creation.

Rhyl, 9th March, 1878.

The City Flora.

BY E. J. BAILLIE.

PRECURSORY CATALOGUE OF PLANTS WITHIN THE BOUNDARIES OF THE CITY OF THE COUNTY OF CHESTER.

THE City bounds may, for guidance, be thus defined:—Starting from the General Railway Station the line of demarcation takes a south-easterly direction, through Boughton, to the little patch of meadow land beyond the Water-Works, near the Fords, thence up the centre of the river to Heron Bridge, thence in a deviating course to Lache Hall, across the Chester and Shrewsbury line of rails, past Saltney Station, across the river, and on to Blacon, near the point where the main road diverges, thence by Finchett's gutter to the Bache Pool, and along Flookersbrook to the Station.

The Catalogue is compiled from the records of City Plants, collected and noted during 1875-77 by Members of the Botanical Section of the Society, and is arranged according to the seventh edition of the London Catalogue, the distinctive index numbers corresponding therewith.

It will be remarked that several important and universally distributed genera, such as *Rubus, Rosa, Potamogeton, Salix, Chenopodium, Atriplex,* and *Rumex,* are not included in the list. The whole of these genera have representatives in the City Flora, but specimens have not yet been critically examined, and therefore no definite specific records have been made. The HON. J. LEICESTER WARREN specially directs attention to the order *Chenopodiacæ,* and we have within the City many species of both *Chenopodium* and *Artriplex.*

Mention should perhaps be made of the existence of several interesting species, well established, within a few yards of the City bounds at various points, but not yet recorded as actually within the City. Amongst others *Symphytum officinale, Spergularia rubra, Sagina nodosa, Schlerochloa distans, Cicuta virosa, Cichorium Intybus, Stellaria aquatica, Saxifraga granulata,* and *Typha latifolia.*

The plants marked * are from records supplied by MR. F. M. WEBB to the HON. J. LEICESTER WARREN for his "Cheshire Flora," and kindly supplied by MR. WARREN for the list of City Plants.

PRECURSORY CATALOGUE OF PLANTS, &c.

No. in London Cat., 7th Ed.	NAME.	LOCALITY.	REMARKS.
1	Clematis Vitalba, Linn.	Hedge of road near Baths, and frequently near Old Gardens.	In all localities evidently a garden escape.
6	Thalictrum flavum, Linn.	Banks of Dee below Curzon Park, and river side near Heron Bridge.	
8	Anemone nemorosa, Linn.	Queen's Park Meadows.	
*14	Ranunculus peltatus, Fries	Canal near the Baths.	
22	,, sceleratus, Linn.	Sealand road ditches ; Queen's Park Meadows	
24	,, Flammula, Linn.	Queen's Park Meadows.	
28	,, acris, Linn.	General—abundant on Roodee.	
29	,, repens, Linn.	,, ,, ,,	
30	,, bulbosus, Linn.	,, ,, ,,	
35	,, Ficaria, Linn.	Roodee Cop ; Avenue.	
36	Caltha palustris, Linn.	Roodee Cop ; Queen's Park Meadows.	
42	Aquilegia vulgaris, Linn.	Hedge, Navigation Cop	A single specimen noted in 1876, but evidently an escape.
51	Papaver Rhœas, Linn.	Sealand Meadows.	
52	,, dubium, Linn	,, ,,	
*53	,, Argemone, Linn	Lache lane.	
57	Chelidonium majus, Linn.	Hedge rows, Sealand ; the Cop.	
64	Fumaria officinalis, Linn.	General.	
*72	Sinapis alba, Linn.	Brewer's Hall Farm-yard.	
*73	,, nigra, Linn.	Lane near Baths.	
*76	Brassica *Napus*, Linn. (?)	Lache lane rubbish heaps.	
81	Diplotaxis tenuifolia, DC.	City Walls	Abundant above Roodee.
83	Sisymbrium officinale, Scop.	General.	
*84	,, Sophia, Linn.	Sealand Meadows.	
86	,, Alliaria, Scop.	General.	
*91	Cheiranthus *Cheiri*, Linn	Chester Walls.	
94	Cardamine pratensis, Linn.	Queen's Park Meadows	During 1877 "double" flowers were abundant.
95	,, hirsuta, Linn.	,, ,,	
98	Arabis thaliana, Linn.	City Walls.	
110	Nasturtium officinale, Brown	Queen's Park Meadows.	
112	,, palustre, DC.	Lane leading to Meadows ; Navigation Cop.	
117	Cochlearia anglica, Linn.	River Cop.	

124	Alyssum *calycinum*, Linn.	Sealand Meadows.	Several plants found in 1877 in one of the Sealand Meadows, probably introduced with clover seeds.
134	Capsella Bursa-pastoris, Mœnch.	General.	
135	Lepidium latifolium, Linn.	Foot of Walls near Watergate.	A natural habitat and old station.
138	,, campestre, Brown.	Sealand ; Meadows.	
140	,, *Draba*, Linn.	Brewer's Hall Meadows ; Cemetery	Abundant in 1877 in Brewer's Hall Meadows, though the station may be destroyed by field cultivation.
142	Senebiera Coronopus, Poir.	Roodee ; City Walls ; Lache lane.	
145	Reseda Luteola, Linn.	River Cop ; Sealand road ; Saltney.	
152	Viola odorata, Linn.	Near Heron Bridge ; Navigation Cop ; Lache lane Wood.	
157	,, canina, Auct.	Queen's Park Meadows ; Navigation Cop.	
160	,, tricolor, Linn.	General.	
173	Dianthus deltoides, Linn.	Grosvenor Park	Probably introduced with Conway gravel (record made by Mr. G. Cross).
178	Silene inflata, Sm.	Sealand Meadows.	
178*b*	,, ,, puberula.	,, ,,	
188	Lychnis vespertina, Sibth.	Sealand road ; Lache lane.	
189	,, diurna, Sibth.	Queen's Park road ; Avenue.	
190	,, Flos-cuculi, Linn.	Queen's Park Meadows ; Sealand.	
193	,, Githago, Lam.	Sealand Meadows	Introduced with Vetches.
200	Cerastium triviale, Link.	General.	
207	Stellaria media, With.	,,	
208	,, Holostea, Linn	Heron Bridge ; Cop.	
210	,, graminea, Linn.	Queen's Park Meadows.	
211	,, uliginosa, Murr.	,, ,,	
213	Arenaria serpyllifolia, Linn.	Navigation Cop ; City Walls.	
*223	Sagina apetala, Linn.	City Walls.	
225	,, procumbens, Linn.	General.	
230	Spergula arvensis, Linn.	Queen's Park.	
*232	Spergularia neglecta, Syme, E.B.	Dee Cop.	
*233	,, marginata, Syme, E.B.	,, ,,	
*251	Hypericum dubium, Leers.	Hedge near Gamon's Rough.	
252	,, tetrapterum, Fries.	Avenue ; Lache lane.	
256	,, pulchrum, Linn.	Sealand.	
260	Althæa officinalis, Linn.	Sealand road	A single plant well established. Each year the spike is destroyed and all chance of extension thus prevented.
262	Malva Moschata, Linn.	Road to Meadows.	
263	,, sylvestris, Linn.	Old Ship Yard ; Cop.	
266	Tilia *intermedia*, DC.	General, *e.g.* Groves ; New road, &c.	
269	Linum catharticum, Linn.	Saltney Fields ; Avenue.	

PRECURSORY CATALOGUE OF PLANTS, &c.

No. in London Cat., 7th Ed.	Name.	Locality.	Remarks.
276	Geranium pratense, Linn.	Sealand Meadows and Queen's Park Meadows	In 1877 a species bearing white flowers was observed within a few yards of the recorded plants of the ordinary species.
278	,, molle, Linn.	Sealand Meadows.	
281	,, dissectum, Linn.	,, ,,	
284	,, Robertianum, Linn.	General.	
285	Erodium cicutarium, Herit.	Navigation Cop.	
294	Ilex Aquifolium, Linn.	General.	
298	Acer *Pseudo-platanus*, Linn.	,,	
299	,, campestre, Linn.	Sealand Meadows.	
300	Ulex europæus, Linn.	Cop ; Gamon's Rough.	
307	Ononis spinosa, Linn.	Cop.	
308	,, arvensis, Auct.	Sealand Meadows.	
311	Medicago *sativa*, Linn.	,, ,,	
314	,, lupulina, Linn.	,, ,,	
316	,, maculata, Sibth.	Little Roodee	Introduced.
323	Trifolium pratense, Linn	General.	
327	,, *incarnatum*, Linn	Sealand	A single specimen recorded in 1876—casual.
336	,, *hybridum*, Linn.	General.	
337	,, repens, Linn.	,,	
338	,, fragiferum, Linn.	Sealand road ; Cop.	
339	,, procumbens, Linn.	General.	
340	,, minus, Relhan.	,,	
342	Lotus corniculatus, Linn.	,,	
344	,, major, Scop.	Sealand road.	
356	Vicia hirsuta, Koch.	Sealand road ; Lache lane.	
357	,, tetrasperma, Moench.	,, ,, Queen's Park Meadows.	
359	,, Cracca, Linn.	General.	
362	,, sepium, Linn.	Town lane.	
364	,, *sativa*, Linn.	Queen's Park Meadows.	
369	Lathyrus Nissolia, Linn.	Lache foot-path.	
371	,, pratensis, Linn.	General.	
376	Orobus tuberosus, Linn.	Gamon's rough.	
378	Prunus spinosa, Linn.	First hedge, Wrexham road.	
382	,, Cerasus, Linn.	Gamon's rough.	
385	Spiræa Ulmaria, Linn.	Queen's Park Meadows.	

387	Agrimonia Eupatoria, Linn.	Queen's Park Meadows.	
389	Sanguisorba officinalis, Linn.	,, ,, ,,	
397	Potentilla Fragariastrum, Ehrh.	Near Heron Bridge.	
400	,, Tormentilla, Schenk.	General.	
403	,, anserina, Linn.	,,	
407	Comarum palustre, Linn.	Queen's Park Meadows.	
454	Geum urbanum, Linn.	General.	
473	Cratægus Oxyacantha, Linn.	,,	
475	Pyrus Aria, Hooker	Grosvenor road.	
480	,, Aucuparia, Gaert.	Avenue.	
482	,, Malus, Linn.	Hedge rows, Avenue.	
487	Epilobium hirsutum, Linn.	Meadows.	
488	,, parviflorum, Schreb.	Old Ship-yard.	
489	,, montanum, Linn.	General.	
*493	,, obscurum, Schreb.	Ledges, City Walls above river.	
507	Callitriche verna, Linn.	Meadow water-course.	
*508	,, obtusangula, Le Gal. (?)	Ditto ditto	
513	Bryonia dioica, Linn.	General.	
525	Sedum acre, Linn.	City Walls ; Cop.	
531	Cotyledon Umbilicus, Linn.	Near Heron Bridge.	
540	Saxifraga tridactylites, Linn.	Sealand Meadows.	
552	Hydrocotyle vulgaris, Linn.	Saltney Fields.	
554	Sanicula europæa, Linn.	Avenue, first plantation west.	
558	Apium graveolens, Linn.	Sealand road : Cop.	
559	Helosciadium nodiflorum, Koch.	Blacon Brook ; Lache lane.	
560	,, inundatum, Koch.	Saltney Field Pits.	
563	Sison Amomum, Linn.	Curzon Park ; Lache lane.	
565	Ægopodium Podagraria, Linn.	Near Sluice House ; Cemetery.	
569	Bunium flexuosum, With.	General.	
*570	Pimpinella Saxifraga, Linn.	Dee Cop.	
573	Sium angustifolium, Linn.	Lache lane.	
578	Œnanthe fistulosa, Linn.	Queen's Park Meadows.	
582	,, crocata, Linn.	Roodee Cop ; Queen's Park Meadows.	
583	,, Phellandrium, Lam.	Meadow water-courses.	
586	Fœniculum vulgare, Gaert.	Sealand road	A few plants introduced with ballast.
592	Angelica sylvestris, Linn.	Little Roodee.	
597	Heracleum Sphondylium, Linn.	General.	
599	Daucus Carota, Linn.	Sealand.	
602	Torilis Anthriscus, Gaert.	Curzon Dingle ; Parkgate road.	
603	,, nodosa, Gaert.	Cop.	

PRECURSORY CATALOGUE OF PLANTS, &c.

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*604	Chærophyllum Anthriscus, Lam.	North outskirts of Chester.	
610	Conium maculatum, Linn.	Lache lane.	
614	Hedera Helix, Linn.	General	Necessarily more or less doubtful as native.
618	Adoxa Moschatellina, Linn.	Heron Bridge.	
619	Sambucus nigra, Linn.	City Walls.	
621	Viburnum Opulus, Linn.	Sealand Meadows.	
624	Lonicera Periclymenum, Linn.	General.	
629	Galium cruciatum, With.	,,	
630	,, verum, Linn.	River Cop.	
635	,, palustre, Linn.	Meadows.	
639	,, Aparine, Linn.	General.	
641	Asperula odorata, Linn.	Avenue, first plantation west.	
643	Sherardia arvensis, Linn.	Cop.	
646	Valeriana officinalis, Linn.	Little Roodee Cop ; Queen's Park Meadows.	
648	Valerianella olitoria, Moench.	Cop.	
652	Dipsacus sylvestris, Linn.	Saltney Fields.	
654	Scabiosa succisa, Linn.	Curzon Park.	
656	,, arvensis, Linn.	,, ,,	
658	Silybum Marianum, Gaert.	River side, near Old Dee Bridge.	
661	Carduus crispus, Linn.	Cop ; Northgate.	
662	,, lanceolatus, Linn.	General.	
664	,, palustris, Linn.	Meadows.	
669	,, arvensis, Curt.	General.	
678	Centaurea nigra, Linn.	,,	
680	,, Cyanus, Linn.	Sealand Meadows.	
684	Chrysanthemum segetum, Linn.	,, ,,	
685	,, Leucanthemum, Linn.	,, ,,	
687	Matricaria inodora, Linn.	,, ,,	
689	Tanacetum vulgare, Linn	Old Ship Yard ; Queen's Park Meadows.	
694	Achillea Millefolium, Linn.	General.	
695	,, Ptarmica, Linn.	Old Ship Yard : Avenue ; Saltney Field Pits.	
697	Artemisia vulgaris, Linn.	General.	
712	Senecio vulgaris, Linn.	,,	
716	,, erucifolius, Linn.	Wrexham road.	

717	Senecio Jacobæa, Linn.	General.	
718	,, aquaticus, Huds.	Sealand road.	
732	Inula dysenterica, Linn.	Lache lane.	
734	Bellis perennis, Linn	General.	
*736	Erigeron acris, Linn.	Old Ship-yard.	
738	Aster Tripolium, Linn.	Cop.	
741	Tussilago Farfara, Linn.	Old Ship-yard.	
745	Lapsana communis, Linn.	Sealand road.	
748	Hypochœris radicata, Linn.	Sealand Meadows.	
751	Leontodon hispidus, Linn.	,, ,,	
752	,, autumnalis, Linn.	,, ,, ; Grosvenor Park.	
755	Tragopogan pratensis, Linn.	Roodee Cop.	
756	,, *porrifolius*, Linn.	Embankment, Railway Tunnel mouth.	
757	Taraxacum officinale, Wigg.	General.	
763	Sonchus oleraceus, Linn.	Brewer's Hall Meadows.	
764	,, asper, Hoffm.	,, ,,	
765	,, arvensis, Linn.	Sealand Meadows.	
770	Crepis virens, Linn.	,, ,,	
774	Hieracium Pilosella, Linn.	Sealand road.	
818	Campanula rotundifolia, Linn.	Liverpool road.	
847	Fraxinus excelsior, Linn.	General.	
848	Ligustrum vulgare, Linn.	,,	
853	Erythræa Centaurium, Pers.	Meadows.	
857	Chlora perfoliata, Linn	Sealand road.	
863	Menyanthes trifoliata, Linn.	Sealand Meadows.	
866	Convolvulus arvensis, Linn.	Roodee.	
867	,, sepium, Linn.	Lache lane.	
873	Solanum Dulcamara, Linn.	Meadows.	
874	,, nigrum, Linn.	Little Roodee.	
877	Verbascum Thapsus, Linn.	Grosvenor Park	Evidently introduced.
886	Scrophularia nodosa, Linn.	Lache lane.	
892	Linaria *Cymbalaria*, Mill.	City Walls; Netherleigh House wall.	
902	Veronica hederifolia, Linn.	Sealand Meadows.	
904	,, agrestis, Linn.	Cop.	
905	,, Buxbaumii, Ten.	Sealand Meadows ; Saltney Fields.	
908	,, arvensis, Linn.	,, ,, ,,	
909	,, serpyllifolia, Linn.	Sealand road.	
915	,, officinalis, Linn.	,, ,,	
916	,, Chamædrys, Linn.	General.	
918	,, scutellata, Linn.	Meadows.	

PRECURSORY CATALOGUE OF PLANTS, &c.

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919	Veronica Anagallis, Linn.	Queen's Park Meadows.	
920	,, Beccabunga, Linn.	Meadows.	
922	Bartsia Odontites, Huds.	Queen's Park ; Saltney Fields.	
927	Rhinanthus Crista-galli, Linn.	General.	
941	Orobanche minor, Linn.	Sealand Meadows	Introduced with clover crop.
943	Lycopus europæus, Linn.	Meadows.	
948	Mentha Piperita, Huds.	Wrexham road.	
963	Calamintha Acinos, Clairv.	Cop.	
968	Nepeta Cataria, Linn.	,, (both sides of the river.)	
969	,, Glechoma, Benth.	Heron Bridge.	
970	Salvia Verbenaca. Linn.	Roodee ; Little Roodee, and adjoining Field.	
972	Prunella vulgaris, Linn.	General.	
973	Scutellaria galericulata, Linn.	Meadows.	
977	Ballota nigra. Linn.	Cop	
978	Stachys Betonica, Benth.	,, (both sides of the river.)	
980	,, palustris, Linn.	Meadows.	
*981	,, ambigua, Sm.	Saltney fields.	
987	Galeopsis Tetrahit, Linn.	Curzon Dingle.	
989	Lamium amplexicaule, Linn.	Sealand Meadows.	
991	,, incisum, Willd.	,, ,,	
992	,, purpurem, Linn.	General.	
996	Ajuga reptans, Linn.	,,	
1003	Echium vulgare, Linn.	Queen's Park road.	
1012	Myosotis palustris, With.	Blacon Brook.	
1016	,, arvensis, Hoffm.	General.	
1018	,, versicolor, Reich.	Curzon Dingle.	
1019	Anchusa arvensis, Bieb.	Sealand Meadows.	
1022	Borago *officinalis*, Linn.	,, ,,	
1037	Primula vulgaris, Huds.	Queen's Park Meadows.	
1038	,, officinalis, Linn.	,, ,,	
1047	Lysimachia Nummularia, Linn.	Queen's Park Meadows ; Lache Lane.	
1049	Anagallis arvensis, Linn.	General.	
1053	Glaux maritima, Linn.	Cop ; Sealand Road.	
1054	Samolus Valerandi, Linn.	Sealand Road ; Queen's Park Meadows.	

1055	Armeria maritima, Willd.	Cop.	
1061	Plantago major, Linn.	General.	
1062	,, media, Linn.	Canal Basin; Saltney Cop.	
1063	,, lanceolata, Linn.	General.	
1064	,, maritima, Linn.	Cop.	
1065	,, Coronopus, Linn.	,,	
1111	Polygonum Convolvulus, Linn.	Sealand Road.	
1113	,, aviculare, Linn.	General.	
1116	,, Hydropiper, Linn.	,,	
1119	,, Persicaria, Linn.	Sealand Meadows.	
1127	Daphne Laureola, Linn.	Lache Lane; Saltney Fields.	
1132	Buxus *sempervirens*, Linn.	General.	
1134	Euphorbia Helioscopia, Linn.	Curzon Park.	
1146	Mercurialis perennis, Linn.	Lache Lane.	
1148	Ceratophyllum aquaticum, E. B. 3	Canal Basin.	
1149	Parietaria diffusa, Koch	City Walls.	
1150	Urtica dioica, Linn.	General.	
1152	,, urens, Linn.	Savings' Bank Gardens.	
1153	Humulus lupulus, Linn.	Lane near Baths.	
1155	Ulmus montana, Sm.	Avenue.	
1156	Quercus Robur, Linn.	,,	
1157	Castanea *vulgaris*, Linn	,,	
1158	Fagus sylvatica, Linn.	,,	
1159	Corylus Avellana, Linn.	,,	
1160	Carpinus Betulus, Linn.	Curzon Park Dingle.	
1161	Alnus glutinosa, Linn.	Meadows.	
1162	Betula alba, Linn.	Avenue.	
1165	Populus alba, Linn.	,,	
1167	,, tremula, Linn.	Queen's Park Meadows.	
1199	Pinus sylvestris, Linn.	Avenue.	
1201	Juniperus communis, Linn.	,,	
1203	Taxus baccata, Linn.	,,	
1204	Typha latifolia, Linn.	Sealand Ditches.	
1206	Sparganium ramosum, Huds.	Blacon Brook.	
1207	,, simplex, Huds.	Lache Field Pits.	
1210	Acorus Calamus, Linn	Canal Basin, near Stone Bridge.	
1211	Arum maculatum, Linn.	Lache Lane.	
1213	Lemna trisulca, Linn.	Meadow Water-courses.	
1214	,, minor, Linn.	,, ,,	
1215	,, gibba, Linn.	,, ,,	

PRECURSORY CATALOGUE OF PLANTS, &c.

No. in London Cat., 7th Ed.	Name.	Locality.	Remarks.
1216	Lemna polyrhiza, Linn.	Blacon Brook.	
1241	Zanichellia palustris, Linn.	Blacon Brook; Cemetery.	
1249	Triglochin palustris, Linn.	Blacon Marsh.	
1250	,, maritimum, Linn.	,, ,,	
1252	Sagittaria sagittifolia, Linn.	Canal Basin.	
1253	Alisma plantago, Linn.	Blacon Brook.	
1257	Butomus umbellatus, Linn.	,, ,,	
1258	Hydrocharis morsus-ranæ, Linn.	Curzon Park Fields.	
1260	Elodia *canadensis*, Mich.	General.	
1268	Orchis morio, Linn.	Queen's Park Meadows.	
1269	,, mascula, Linn.	Field off Curzon Park.	
1273	,, maculata, Linn.	Meadows.	
1289	Listera ovata, Brown	Curzon Dingle.	
1307	Iris Pseudacorus, Linn.	Canal.	
1317	Tamus communis, Linn	Gamon's Rough.	
1325	Ruscus aculeatus, Linn.	Savings' Bank Gardens.	
1341	Allium vineale, Linn.	Roodee Cop.	
1342	,, oleraceum, Linn.	,, ,,	
1355	Luzula campestris, D.C.	General.	
1365	Juncus conglomeratus, Linn.	Blacon Marsh.	
1366	,, effusus, Linn.	Blacon Marshes.	
1368	,, glaucus, Sibth.	Meadows.	
1377	,, bufonius, Linn.	Sealand Road.	
1378	,, Gerardi, Lois.	,, ,,	
1390	Scirpus palustris, Linn.	Meadow ditches.	
1405	,, maritimus, Linn.	Blacon Brook.	
1424	Carex vulpina, Linn.	Meadows.	
1428	,, remota, Linn.	,,	
1433	,, curta, Good	,,	
1442	,, vulgaris, Fries	Sealand Meadows.	
1443	,, glauca, Scop.	Curzon Park.	
1452	,, præcox, Jacq.	,, ,,	
1455	,, panicea, Linn.	,, ,,	
1459	,, pendula, Huds.	Meadows.	

1465	Carex distans, Linn.	Sealand Road; Queen's Park Meadows.	
1472	„ hirta, Linn.	Meadows.	
1475	„ riparia, Curtis	„	
1476	„ ampullacea, Good	„	
1488	Anthoxanthum odoratum, Linn.	General.	
1489	Digraphis arundinacea, Trin.	River Cop.	
1490	Phalaris *canariensis*, Linn.	Lache Lane and Sealand Road	Casual.
1493	Alopecurus geniculatus, Linn.	General in marshy places.	
1495	„ pratensis, Linn.	General.	
1498	Phleum pratense, Linn.	„	
1510	Agrostis alba, Linn.	„	
1511	„ vulgaris, With.	„	
1520	Aira cæspitosa, Linn.	Queen's Park Meadows.	
1523	„ flexuosa, Linn.	„ „	
1526	Avena flavescens, Linn.	Sealand Meadows.	
1527	„ pubescens, Linn.	Queen's Park Meadows.	
1531	„ Elatior, Linn.	General.	
1532	Holcus mollis, Linn.	Queen's Park.	
1533	„ lanatus, Linn.	General.	
1534	Triodia decumbens, Beauv.	Queen's Park Meadows.	
1536	Molinia cærulea, Mœnch.	„ „	
1539	Catabrosa aquatica, Beauv.	Bache Pool.	
1540	Glyceria fluitans, Brown	General.	
1542	„ aquatica, Sm.	River Cop, all the way within City bounds.	
1549	Poa Annua, Linn.	General.	
1556	„ nemoralis, Linn.	Queen's Park, City Walls, and Dee Mills.	
1558	„ pratensis, Linn.	General.	
1559	„ trivialis, Linn.	Queen's Park.	
1560	Briza media, Linn.	Sealand Road.	
1562	Cynosurus cristatus, Linn.	General.	
1564	Dactylis glomerata, Linn.	„	
1567	Festuca Pseudo-myurus, Soyer	Old Ship-yard.	
1569	„ ovina, Linn.	Sealand Meadows.	
1570	„ rubra, Linn.	Meadows.	
1575	Bromus asper, Murr.	Wrexham Road.	
1579	„ sterilis, Linn.	„ „	
1583	„ mollis, Linn.	General.	
1585	Brachypodium sylvaticum, R. & S.	Gamon's Rough; Avenue.	
1588	Triticum repens, Linn.	General.	
1592	Lolium perenne, Linn.	„	

PRECURSORY CATALOGUE OF PLANTS, &c.

No. in London Cat., 7th Ed.	Name.	Locality.	Remarks.
1593	Lolium *italicum*, Braun.	General.	
1595	Lepturus filiformis, Trin.	City Walls, near Dee Mills.	
1598	Hordeum murinum, Huds.	Roodee.	
1606	Pteris aquilina, Linn.	City Walls	On ledge of Walls between the Northgate and Phœnix Tower; and a single specimen, recorded in 1876, growing on ledge of City Walls, Castle.
1609	Asplenium Ruta-muraria, Linn.	,,	
1616	,, Adiantum-nigrum, L.	,,	
1620	Scolopendrium vulgare, Sm.	,,	
1629	Nephrodium Filix-mas, Rich.	Queen's Park Meadows.	
1634	,, dilatatum, Desv.	,, ,,	
1638	Polypodium vulgare, Linn.	,, ,,	
1645	Ophioglossum vulgatum, Linn.	,, ,,	
1658	Equisetum arvense, Linn.	Avenue.	
1663	,, limosum, Linn.	Sealand Road.	
1676	Chara fœtida, Braun.	Blacon Brook.	
Excluded Species.	Saponaria vaccaria, Linn.	Little Roodee	Single plant, 1876. Probably introduced with "ballast."
	Xanthium spinosum Linn.	Field near Barracks	Single plant, 1876. Introduced by foreign sheep.
	Datura Stramonium, Linn.	Planting in George Street	Several plants—casuals.

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Notes on the Geology of the Vale of Clwyd.

BY T. McKENNY HUGHES, M.A., F.S.A., F.G.S.,

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Read in abstract Thursday, November 25th, 1880.

THE area drained by the Clwyd and its tributaries is one of the most interesting in North Wales, whether we look to its Geological structure or to the struggles that have been going on in it since man has dwelt there. Its rich pastures and pleasant dwelling places have been well fought over from the earliest period of which we have any history, and far back into what are called prehistoric times—as witness its numerous castles with their battered towers, and its ancient camps with ditches full of dead men's bones. And before man had fairly established himself there, fierce wild beasts, whose remains are found in its caverns, struggled for the monopoly of the most secluded lairs and richest feeding grounds. As we trace the history back we find that the district has always been subject to great vicissitudes, geologically speaking; to successive conquests of land by sea and of sea by land.

In fact we meet at the commencement of our enquiry a suggestion of one of the great laws of geology, that what has been an elevated range in very remote periods is generally elevated over and over again, and therefore along the edge of a mountain region we are apt to find traces of ancient denudations, showing the waste of rising lands; and there we find also the shingle and sand indicating shore deposits as the land went down and up again in each successive era. So on the border lands of Wales we find the shore deposits of the Carboniferous sea creeping up ancient valleys in the old Silurian and Cambrian rocks. And again the earliest New Red rocks, pockety patches of the base of which are sometimes wrongly called Permian, show a recurrence later on of very similar conditions to what we had at the commencement of the Carboniferous Period.

There is not much written on the Geology of the Vale of Clwyd. Ramsay Mem. Geological Survey, Vol. iii., devotes 7 pages to it (222—8); a few other Papers on special points will be noticed in their proper place.

There are five plains distinguishable from the hills that bound the Vale of Clwyd—

No. 1.—The plain of the Carnarvonshire mountains, having an average height of about 3,000 feet, and probably part of the same plain as that of the Lake District mountains which attain about the same average elevation.

No. 2.—The plain of the Denbigh Grits and Flags which rises to the S. and W., and may have been continuous with the 2,000 foot plain of South and Central Wales. This is the plain that you see stretching from the Black Mountains in Carmarthenshire right up to the great North Wales group, mentioned above, No. 1; interrupted by Plinlimmon only, which mountain must have formed an island when the sea was planing the old land down from the 3,000 to the 2,000 foot level. This is probably part of the second plain of the Lake District, namely, the plain of the Carboniferous moorlands of Western Yorkshire and Northern Lancashire, which cuts across the Silurian of the Howgill Fells, and at an average level of something under 2,000 feet, carries the eye along to the ancient shore cliffs of the higher Lake Mountains.

There is a suspicion of another level, at about 800 feet, both in the Lake District and in North Wales, but I have not been able to make it out satisfactorily.

No. 3.—Within the Vale of Clwyd (see fig. 1) three other plains can be made out. They might be called terraces, but two of them are probably marine, and traceable into other and larger areas where they may fairly claim the title of plain. The highest is the plateau on which Plas Heaton stands. It is generally covered by more or less continuous patches of the Clwydian marine drift. It was the bottom of the valley before the gorge of the Elwy was excavated.

No. 4.—There is below this, at a level of about 80 feet above the sea, the level surface of the old estuary of the Clwyd, on which the Cathedral of St. Asaph stands. This seems a plain of deposition, and the low flat hills and spurs which have been left between and on either side of the modern streams of the Clwyd and Elwy are composed of the estuarine drift described hereafter.

No. 5.—The Clwyd and Elwy have cut their channels down some 80 feet or so through the old estuarine deposits, and have formed alluvial flats which, near their mouth, open out into the wide marshy ground known as Morfa Rhuddlan.

FIG. 1.

Generalized Section E. and W. across the Vale of Clwyd from the upper part of the Elwy valley to Caerwys.

a. Red sand and gravel.
b. Red clay with stones large and small, some scratched, some not.
On the West side of the Clwydian range the red sand and gravel, with shells, slopes up to the South. The sand and gravel is not seen when we get as high as Plas Heaton. On the East however, of Moel-y-gaer, the red sand and gravel in which here, however, I found no shells, seems to attain a height equal to that of Plas Heaton, and runs up the Wheeler Valley in hummocky hills, at any rate as far as Caerwys. Standing on Moel-y-gaer the highest of these and Plas Heaton seem to form part of an old plain stretching away as far as the eye could reach to the country S.W. of the Dee.
c. New Red. *d.* Carboniferous. d^1 Limestone. d^2 Sandstone. d^3 Conglomerate.
e. Silurian. *f.* Faults.

I propose to treat the subject in a very sketchy way, just describing a typical section in illustration of each group, or calling attention to some sources of error for the guidance of future observers who may be beginning to work at the district, or pointing out here and there what I think are necessary modifications of the interpretation of previous observers.

I shall begin with the oldest rocks in the district, and describe them in ascending order.

THE BALA SERIES.

The Bala Beds do not occur in what is popularly known as the Vale of Clwyd; but to the W. of Derwen Station and N. of Bettws-y-gwerfilgoch the river Clwyd runs through them for about two miles, and a belt of rock, to be referred to the same age, occurs on Bryngorlan, one of the hills that bar the upper end of the vale, 3 miles S. of Llanfair-dyffryn-clwyd (see Section fig. 2.) These beds, which belong to the uppermost part of the Bala Series, consists of grey or paste-coloured fine mudstone, irregularly and roughly but strongly cleaved—often showing double cleavage.

FIG. 2.

a. New Red Sandstone.
b. Stained Carboniferous Sandstone seen in cave and on road near Penygraig.
c. Mountain Limestone.
d. Basement Beds of Mountain Limestone (= Devonian.)

e. Denbigh Flags.
f. Lowest shales of Silurian, having as the basement bed
g. Whitish Grit, about 50 feet thick, becoming finer as we follow it to the west, until it is represented by striped nodular beds, the nodular character being due to squeezing up of lenticular beds of sandstone.
h. Bala Beds, consisting of light-coloured slate, sometimes showing double cleavage.

From the beds on Bryngorlan I procured *Leptæna sericea,* and *transversalis*, *Strophomena rhomboidalis*, *(Dalm)*, *Palæarca* and various indeterminable fragments. These fossils do not certainly fix the horizon, but the geological position of the beds, suggested by their lithological character, is rendered more probable by the determination of the base of the Silurian which overlies them on the south. [See Q.J.G.S., Vol. xxxiii., 1877, p. 207.]

We hope for valuable results from the excellent work being done by Mr. RUDDY among these rocks a little further south in the Dee Valley.

The beds passed over by the Clwyd, N. of Bettws-y-gwerfilgoch, belong to the same part of the Series. They are well exposed further S. and W., and form the uppermost part of the main mass of Bala in its typical district.*

The same beds are exposed on Cyrnybrain (see fig. 3.), a district that requires and would probably repay careful work. There are some fossiliferous shales on the South Eastern slopes which seem to belong to the Lower May Hill Series (* of fig. 3.)

FIG. 3.

Section across hills S. of Vale of Clwyd.

A^1 Silurian Flags and Sandstones.
A^2 Dark bluish slates, extensively quarried.
A^3 Pale Slates.
A^4 Coarse fossiliferous Grit, broken up along the outcrop.
* (?) Some Lower May Hill Mudstone.
B^1 Bala Beds with fossils.
B^2 Bala Sandstone.
F Faults.

SILURIAN (SEDGW.)

Overlying the Bala Beds we always find a series of deposits showing a change from the conditions which furnished the fine felspathic muds of the Bala Series, and yet there seems to have been much of the same kind of material derived either first hand or second hand from volcanic eruptions, still carried about in the currents, so that we often have pale, pasty, felspathic mudstones in the base of the Silurian. There is not evidence of any strong break; it is not clear that the sea bottom was raised above the water level, or that land conditions prevailed in this area between the two periods, but we always have a sudden incoming of coarser material, a conglomerate, or a grit or

* For some of the subdivisions of the upper beds see Marr Q.J.G.S., Vol. xxxvi., p. 207.

alternations of sandstone with the mudstone, showing that there had been changes somewhere near, exposing land to more rapid denudation and permitting the existence of currents which could carry much coarser sediment over our area. [See Q.J.G.S., Vol. xxxiii., May 1877, p. 207.] This is confirmed by palæontology; for these changes, whatever they may have been, seem to have unsettled the conditions upon which life depends, not only in our district, but all over Europe, and so we find at this horizon a new fauna commencing. We must notice another remarkable fact with regard to the Silurian. In South and Central Wales we have a different type from that which prevails in North Wales—so much so that we cannot correlate the subdivisions—but of this I will speak again when I come to the details.

The sandy Mudstones are generally of a pale colour, and are associated with fine pasty rock known as the Pale Slates.

Sometimes we find in these mudstones and slates thin bands of black shale, with graptolites. The species I have found are *Monograptus convolutus, (His), M. triangularis, (Harkn.), M. tenuis, (Portl.), M. Sp.* The beds probably represent in part the graptolithic mudstone of the Lake District. I think that zones could be locally distinguished, and many of them correlated with those of other areas. This stage passes up occasionally through beds of wavy banded sandstone, into flaggy shales with subordinate beds of sandstone, into the main mass of the Denbigh Grits and Flags. It is exposed here and there on Bryngorlan, at the South end of the Vale of Clwyd, and may be well examined in the gorge of the Clwyd under Dinas, W. of Derwen Station, and between the valleys of the Clwyd and Dee (see figs. 1 & 2.) [See Q.J.G.S., Vol. xxxv, Nov. 1879, p. 697.] I would here offer an explanation as to the use of the term grit. A geologist who had been working in the Carboniferous rocks would be puzzled if he searched for grit in the Silurian of our district. His idea of a grit would be the Millstone Grit, but among the Silurian and Cambrian rocks the term is applied to any sandstone which has been consolidated into a tough massive rock, showing no cleavage, seldom splitting along the bedding and feeling rough to the hand. The grains of which it is composed are generally much smaller than those which make up the sandstones of the Carboniferous rocks. It is in fact a sandstone being changed to quartzite, and it has been proposed to use the old word Grauwacke as a lithological term for this class of rock. [Geol. Mag., Vol. iv., pp. 229—355, footnotes.] Very likely Grauwacke will be required as a stratigraphical term to include everything from the base of the Cambrian to the top of the Silurian, and perhaps all the beds conformable to them. So it will be better for the present to use the term sandstone instead of grit for these Silurian deposits, except in the case of a few thin beds in which the grains are so large as to fairly entitle the rock material to the name of grit, as for instance among the

Silurian rocks of Caer Drewyn and other places in the Dee valley near Corwen.

Thus we get up into the main mass of the Denbigh Grits, Sandstones, and Flags, a series many thousand feet thick. These are the "blue rock" which occurs along the Clwydian range, and behind the Mountain Limestone from Llandulas to Derwen and from Derwen to Llandegla; in fact it occurs at the back of the Limestone all round the Vale of Clwyd. The Geological Survey has not yet attempted to subdivide these rocks further than to indicate, by yellow dots, the more sandy portions; but I think that with experience of the Lake District, and of Scotland, much may now be done towards subdividing and correlating these rocks with those of other areas. The sandstones are not constant either as to horizon or thickness, but they are apt to occur at about the same part of the series. The palæontology also has not been worked at over a sufficiently large area, or in sufficient detail, to allow us yet to generalise much upon it. I have given a sketch of the sequence and a few short lists of fossils from these beds in the paper before cited.

The Silurian of the Clwydian range does not offer such good opportunities of establishing a sequence as that on the west of the valley, because it is cut off above and below by faults and unconformities, so that there is no well-marked horizon to start from; but if the blue mudstones with subordinate striped and banded flaggy beds, such as those in the Rhiallt quarry, and the grits and sandstones of Moel Arthur, &c., were carefully traced and mapped, and the fossil zones, such as that of Tirgwyn, followed up, we might hope to do something in the way of correlation.

The following sketches may suggest lines along which the sequence might be worked out:—

In a small quarry by the road side in Lady Bagot's drive, about 100 yards N. of where the *g.* of Pantglas is engraved on the ordnance map, and about 300 yards N. of the farm Yr Hengoed, near Rhewl, there are blue flags, with straight or wavy white and grey bands and lines, in beds from 2 to 6 inches thick. There are some concretionary bands with stromatopora-like structure.

In a quarry about 200 yards below the meeting of the streams near Gelli there is a similar banded rock with small concretions, worm-tracks, and a few fossils, such as *Orthoceras primævum*, *Monograptus*, too ill-preserved to make out species, but most like *M. Colonus*.

About 100 yards still further down the stream the bedding is less obvious, but the texture of the rock is much the same.

The sequence, as seen between this and the highest beds seen on Careg-y-gath, is shown in the following diagram sketch, fig. 4.

FIG. 4.

Diagram Sketch of sequence of Silurian from near Rhewl, by Cyfylliog to Careg-y-gath. (No scale.)

a. Pale-grey massive sandy mudstone, slightly cleaved; bedding generally obscure.
b. Grey tough beds, a few inches thick, in dark grey shale, which weathers into a fine "rab." Some concretionary bands concentrically marked in shades of grey.
c. Tough grey thin-bedded wavy-banded concretionary mudstone; encrinites, &c., occur in the heart of concretions. Holes as if due to weathering out of nebulipora.
d. Dark evenly-striped flags.
e. Tough massive banded sandstone and flags.
f. Pale mudstones, with somewhat wavy lines.
g. Alternations of blue flags, with massive rock in which the bedding is not clear.
h. Even-bedded striped and banded rock.
k. Massive grey rock; texture fine; bedding obscure.
l. Bluish-grey slabby shale, evenly banded with white; fossils abundant in some beds (see lists p. 8.)
All minor faults and folds omitted.

It is not a fact that grits prevail in the lower part of the series, and flags and shales in the upper—rather the contrary. As the Coniston Flags are below the Coniston Grit, so also in North Wales flaggy and shaley beds predominate in the lower part, and tough grey sandstones in the upper, until we get up to the horizon of the Bannisdale Slates.

It will be seen that there is a greater similarity between the series in North Wales and the Lake District than there is between that of North and that of South Wales. The principal character in which they differ is the occurrence of three important limestones in the Southern area, which are altogether wanting, or represented only by occasional calcareous bands, in the North. A considerable part of the Southern series consists of rubbly mudstone, while the Northern beds generally run into flags or sandstones. A great difficulty meets us at once when we try to compare them palæontologically, and that is, that the list of Wenlock and Ludlow fossils from the South include the fossils of the limestone also, which of course belong to different conditions and do not offer fair data for comparison. I am glad to learn that MR. MAW and the REV. H. G. DAY are beginning to work out the various horizons in the shale in detail, and hope that important results may be arrived at.

The facies of the fossils of the Denbigh Grits and Flags is more like that of the Ludlow than of the Wenlock, as far as any difference exists between those two stages. It is more obvious when we are searching for fossils in the field than when we are examining classified lists of the species that occur in each, as it depends upon the abundance of individuals of certain species rather than upon the occurrence of species peculiar to one or other age.

The following is a list of those which I have happened to come upon in the localities named:—

List of Fossils from Silurian Mudstone at Pontyrddol, St. Asaph.

Favosites fibrosa	*Rhynchonella navicula*
Heliolites interstinctus (?)	*R. nucula*
Petraia sp.	*Spirifera elevata*
Encrinites	*Leptæna* small form *(?) minima*
Pterinea retroflexa	*Strophomena depressa*
Atrypa reticularis	*S. euglypha*
Chonetes lata and young *(?)*	*Phacops*
Orthis elegantula and var. lunata	*Orthoceras*

List of Fossils from Silurian Mudstones on Moel Fodia, Denbigh.

Heliolites interstinctus	*Chonetes lata*
Nebulipora lens	*Orthis elegantula*
Cliona antiqua	*Rhynchonella navicula*
Atrypa reticularis	*R. nucula*
Pterinæa	*Strophomena depressa*
Ctenodonta	*S. sp.*
Atrypa reticularis	*Phacops (?)*

List of Fossils from Silurian Mudstone near Pontuchaf, Rhewl.

Nebulipora (?)	*Rhynchonella navicula*
Encrinites	*R. nucula*
Atrypa reticularis	*R. Wilsoni (?)*
Chonetes lata	*Strophomena depressa*
Orthis elegantula	*Orthoceras primævum*

A fuller list by Salter, from what I consider to be equivalent beds to those of Pontyralltgoch, will be found in the Mem. Geological Survey, Vol. iii., p. 278. See also Aveline Explanation, Hor. Sect., Sh. 43.

We have not the highest beds of the series in North Wales. They had all been swept away in the great period of upheaval and denudation that elapsed before the land went down again to receive the vast marine deposits of the Devonian and Carboniferous. How much is gone we have not evidence to show, because there is no means of identifying the exact place in the series of the highest beds which have been left. Probably, from the analogy of adjoining districts, there was a vast thickness of sediment deposited above the highest Silurian rocks of our area, and the sediment, under the great pressure to which it was exposed, was hardened into rock. Then in the crumpling and folding of earth crust it all began to rise again from below the sea level, and as it came up it was eaten away by rain, rivers, and sea. If we take just the bit that comes in the valley of the Clwyd, the minimum thickness of rock removed in that interval, *i.e.*, the thickness of the strata from the Bala Beds of Bryngorlan to the highest Silurian seen on Moel Ganol, would be about 1½ miles; but much of the denudation that exposed the edges of the Cambrian Rocks all over North Wales probably belongs to this interval also, in which case we are speaking of a thickness of 8 or 9 miles. What was that ancient land like, and what plants and animals lived on it?

DAWSON has described a plant from the Silurian of America; so we need not be surprised to find remains of vegetation in the much later period of continental conditions that preceded the formation of the Devonian and Carboniferous. But we are not left in doubt to speculate on the probability of there having been plants in that old land in our district. In the sand of the sea that washed its shore we may gather for ourselves the leaves and sticks that were carried down from it. The sea sand, it is true, has long been hardened into sandstone, and the wood is blackened and charred by the slow combustion which chemists call oxidization.

It is probable that the Southern area (South Wales and Devonshire) went down before our district; perhaps much of it never got fairly above the sea level at all. For whereas in our area we have evidence of great denudation of the underlying Silurian, in the South there does not appear to be this sweeping away of the older rocks, and so we find there the Silurian passing up into a vast and generally unfossiliferous series of deposits known as the Lower Old Red. In our area again there are only thin patches of coarse sediment forming the basement beds of the Carboniferous, while in the South there are such enormous deposits of sediment at the base of the Carboniferous series that they have been exalted into a separate formation, under the title of Upper Old Red Sandstone or Devonian.

CARBONIFEROUS SERIES.

The above considerations having led us to infer that there was in our area an enormous interval between the Silurian and Carboniferous Periods, we are prepared to expect that there will be no great difficulty in separating them. There might have been, it is true, a recurrence of similar lithological character, and the base of the newer series, being made up of the underlying rocks, might have been hard to distinguish from them, but it does not happen to have been so. The palæontological break is almost complete.

I have dropped the name Old Red for any of these beds, considering them to be simply the irregular basement beds of the Carboniferous Rocks, as I long ago pointed out in the similar case in the North of England. [Notes on the Geology of Parts of Yorkshire and Westmorland, Geol. P. of Soc. West Riding, 1867.—Mem. Geol. Survey, Expl. 98 S.E., p. 16, 1872.] The beds we have are merely the patches of sand and shingle washed into hollows as the Carboniferous sea encroached on the land. It is not a distinct formation in any way, but only an irregular and local basement bed.

FIG. 5.

Section across base of Carboniferous Rocks in the N.W. corner of the Vale of Clwyd.

a. Mountain Limestone with * caves.
b. Basement Bed of Carboniferous, consisting of yellow and red sandstones and conglomerate of very variable thickness.
c. Denbigh Flags.

It is seen as a coarse conglomerate South of Llysfaen (see fig. 5), where it was noticed by BOWMAN in 1845, (Trans. Geol. Soc., Vol. vi., p. 195,) and its further extension to the South was pointed out to us by MR. PRICE when we made an excursion into that district. Its character has since been fully described in a paper by MR. A. O. WALKER and MR. STRAHAN. (Q.J.G.S., Vol. xxxv., p. 268.) From this point it may be seen at intervals cropping out from below the Mountain Limestone to near Dinorben, S.S.E. of Abergele. There is then an interval of about 3 miles, and it is again picked up near Pontyrddol, on the Elwy, and traced by the colour of the soil and an occasional outcrop for a considerable distance to the S.E. I have not been able to verify it as so uniform and continuous as indicated upon the Survey Map. In the bed of a small tributary of the Elwy, near Brisgill, between Pontyrddol and Pontnewydd, it is exposed for a short distance, and is seen to consist of yellowish and grey sandstones with subordinate bands of shale. It is a distinctly Carboniferous-looking rock, and contains fragmentary plant remains. I do not know that there is any indication of it on the East of the Vale of Clwyd; whether this is because it has been thrown down out of sight by faults, or because it is covered by drift, or because that area was further away from the sediment-supplying mountains. It may be seen along the valley of the Clywedog in several places. Between Buarthau and Felin Meredith the top beds of the Basement Series are exposed below the Mountain Limestone, which is faulted against a lower portion of it (fig. 6.) There is a passage, though a somewhat abrupt one, down from one formation to the other. A little further on, the base of the Devonian is seen resting upon the upturned and jagged edges of the Silurian (fig. 7), while still further south, in the stream below a cottage South West of Llanfwrog, near Ruthin, the same basement series is exposed, but here it lies upon less highly inclined Silurian Flags (fig. 8.)

In a tributary of the Clywedog, near Pandy, about a mile South of Llanrhaiadr, the Mountain Limestone is brought in contact with micaceous Silurian Flags, by a fault probably running along the bottom of the gorge, but it soon seems to leave the fault, and the boundary line creeps away up the hill towards Penybyrn. Along the smashed rock near the fault in the weathered surface of the Silurian, and perhaps also in the sandy beds of the Carboniferous basement series, there have been mining trials. A section exposed just above the shaft showed 8 inches of limestone resting on 18 inches of red and grey shale. In the débris there were traces of copper and some iron pyrites.

FIG. 6.

Section seen between Buarthau and Felin Meredith, near Rhewl. (Scale, 40 feet to 1 inch.)

a. Gravel; probably old river terrace.
b. Mountain Limestone.
c. Basement Bed of Carboniferous (= part of Devonian or Upper Old Red); consisting of beds of Sandstone, 6 to 8 inches thick, in red, grey, and green shale.
f. Fault.

FIG. 7.

Section seen in bank of river near Felin Meredith, Rhewl. (Scale, 5 feet to 1 inch.)

a. Gravel; old river terrace.
b. Basement Bed of Carboniferous (= part of Devonian or Upper Old Red.)
c. Silurian Flags, upon the upturned and jagged edges of which the Devonian lies.

FIG. 8.

Section seen in stream below cottage S.W. of Llanfwrog, Ruthin.

a. Devonian or Basement Bed of Carboniferous; no conglomerate seen at base.
b. Silurian. Flaggy shales; top stained like the "Moughton Whetstones."

THE MOUNTAIN LIMESTONE.

The Mountain Limestone is, I think, capable of subdivision, in some parts of the district at any rate.

There are many beds of peculiar character which help one to trace certain horizons for short distances, and which may some day prove of considerable classificatory value when the zones of life also have been worked out. Some of these beds are of economic value—the bands of thin-bedded limestone in the Tyddyn Uchaf Quarries, near Denbigh, for instance, which naturally split up into blocks of convenient thickness for building purposes; and the even bedded, sometimes oolitic limestone of the Henllan Quarry—where there are also some curious layers of fine buff soapy clay, and bands of a lithographic stone. In the quarry at Penisaf-y-glasgoed, near Bodelwyddan, there is along one side of the quarry a bed, about 2 feet thick, of grey, yellow, and rusty clay, belonging to the Mountain

Limestone. On the other side of the quarry, where the water has percolated to the limestone between the patches of drift, the concretionary character of one of the beds is brought out, and it weathers to a knobly rock. Near the bottom of the quarry there is a bed, about 8 inches thick, in which the difference between the concretionary crystalline rock and the more aluminous portions is shown by darker and lighter shades of grey and brown, producing a mottled limestone like that known as the " Anglesey Marble."

The top of the Mountain Limestone is sometimes split up by sandstones, anticipating as it were the great sandstone series above. This may be seen near Llanfair-dyffryn-clwyd, as shown in the section fig. 2, *b*.

Here another difficulty presents itself. Owing to the overlap of the New Red Rocks, the more porous beds of the underlying Carboniferous are deeply stained with red iron oxide. The same things happened in the case of the Knaresborough Grits (see WARD) and of the Carboniferous Sandstone of the Eden Valley, where the stain has been proved to a depth of 120ft. So around the Vale of Clwyd the sandy beds of the Carboniferous series are stained by the New Red, and have often been thrown in with the New Red. The above-mentioned sandstones on the top of the Mountain Limestone, near Llanfair-dyffryn-clwyd for instance, and the sandstones referred by MR. MAW, Geol. Mag., Vol. 2, (1865) pp. 380—524, to Permian, are, I think, certainly Carboniferous beds above the Mountain Limestone, as suggested by MR. D. C. DAVIES, Geol. Mag., Vol. 2 (1865), p. 478.

MR. CORNWALLIS WEST took me to see the pits dug by MR. EDWARDS, and I found in the rock thrown out several plant remains, which were all undoubtedly Carboniferous.

More clearly still, the beds which crop out in the bank of the Elwy, S. of Pontyralltgoch, must be referred to the Carboniferous. The bright red stain in some of the sandy shale, close to the bridge, induced a speculative miner to sink a shaft close to the bridge, and in the bed which was touched near the bottom of the shaft, about 15ft. from the surface, I found some small fragments of plants, one of which has been referred by MR. CARRUTHERS to *Sphenophyllum schlotheimi Brong.* (See Schimper's Paléontologie Végétale, p. 339.) The rest are parts of stems and bits of what look like Stigmaria rootlets. The specimens are all in the Museum of the Chester Nat. Sci. Soc.

This discovery I was unfortunately unable to follow up, as the whole thing fell in immediately afterwards, burying the windlass and other tackle at the bottom. But it is quite enough to confirm the suspicion arrived at from the lithological character of the rocks, that the boundary of the New Red must be carried forward at any rate to the river under Maeselwy.

FIG. 9.

Corner of Elwy, above Pontyralltgoch, near last letter of Ffynnonfair (Scale, 20 feet to 1 inch.)

a. Red-stained sandstone.
b. Fissile red-stained sandy shale, with plant remains.
c. Reddish shale.
d. Sandstone.

At the bend of the Elwy, above Glanllyn, near Pontyralltgoch, there is a section where the river has undermined the bank and caused a slip. Talus generally obscures the upper part of the section and covers the base. The sketch (fig. 9) gives the result of observations made at various times when different parts had been exposed by the rain and river. In the shaly beds I found indeterminable fragments of plants. These beds are probably about the same horizon as those passed through in the shaft close to Pontyralltgoch.

Now we might speculate upon the correlation of these sandstones and shales which immediately succeed the Mountain Limestone of our district. Are they homotaxeous with the Millstone Grit or with the Yoredale Rocks, or are they of the same age as the upper part of the Mountain Limestone of adjoining areas? I confess I have no opinion on the subject, and should merely call them Carboniferous sandstones and shales, adopting, for the present, local names for the more marked sub-divisions.

Two Well sections in the neighbourhood, which I owe to the kindness of my friend MAJOR BIRCH, are worth recording here, though I am unable to correlate all the beds named.

The first was sunk at Maeselwy, not far from Pontyralltgoch. They passed through

Clay	54′	0″
Clay, with boulders	0′	10″
Red laminated marl	5′	0″
Red and mottled clay	66′	0″
Red sand passing down into sandstone		

The other Well was sunk close to Llanerch, not far from the Clwyd. They there passed through

Clay	37′	6″
Sand	9′ to 12′	0″
Red Sandstone	36′	0″

The sandstone at the bottom of the well at Maeselwy was probably the stained Carboniferous of the Elwy sections above described, but that at the bottom of the Llanerch Well I should think may have been New Red, which is exposed in the wood to the North.

A boring was made many years ago to ascertain whether the coal-measures did not extend beneath the New Red in the

Northern part of the Vale, and it is recorded that the attempt was not abandoned until they had passed through 98 feet of sand, gravel, and clay, probably recent estuarine deposits, and 648 feet of alternations of red and white sandstones and shales.

A subsequent boring (1875-6) near Aberkinsy was given up after they had passed through 480 feet of red rock. At 300 feet they came upon bands of red marly shale. Much of the material which was brought up was a dark red soft clayey sandstone; but it was so crushed and mixed by the boring apparatus that it was difficult to form an opinion as to its character. I have been unable to learn, in either case, whether some of this red rock was not stained Carboniferous, nor do I know whether those who put down the bore consulted anyone competent to give an opinion on the question. The faults of the district should be carefully worked out before anyone can safely speculate upon the difficult question of the occurrence of coal under the New Red, and as I am aware that my friends Mr. Tiddeman and Mr. Strahan are engaged upon this work, I will not offer any remarks about it further than to point out that there is evidence about W. of Ruthin, Llanrhaiadr, Pontyralltgoch, and Cefn, of systems of faults, affecting the Silurian and Carboniferous, running into the valley oblique to its general direction.

There seems to be reason for suspecting a fault running N.E. and S.W., about 50 yards lower down the road than the Pont-newydd Cave; from the abrupt ending of the limestone in a sort of cliff on that side; from the occurrence of fragments of vein stuff, calcite, hæmatite, &c., along that line; and from the depression crossing the hill in its continuation just opposite the school.

Here it is probably cut off by another fault running N., 10° W., from near Dolben, through the hollow, W. of the school, and through the yard of Bedd-y-cawr.

N. of the "en." in Pen-y-cefn, W. of St. Asaph, there are some lodes which have yielded a small quantity of lead. They run magnetic N. and S., and magnetic E. and W., and also sometimes along the bedding, dipping about 10° E.N.E. to N.N.E. All these lodes are very irregular, and can hardly be said to be more than pockets and veins of various minerals in a crushed and broken part of the limestone, but that crushing is connected with a magnetic N. and S., and a magnetic E. and W. set of faults. There are many voogs or caves, some of which are water channels, some filled with clay, and some generally dry, except after wet weather. The water is checked by the rapid accumulation of stalactite. The clay did not look as if it had been carried in through large openings, but as if it had been filtered through rubble or small fissures.

When the lode conforms to the bedding there is generally below it a bed of soapy shale, which seems to have arrested the water; and above it there is often a sandy bed, as if the calcareous material of the rock had been partly removed by chemical action. This bed must also have been originally more sandy than the rest of the limestone. The common minerals are *calcite*, *barytes*, and white and violet *fluorspar*.

THE WEATHERING OF THE MOUNTAIN LIMESTONE.

One of the most marked features of the Mountain Limestone is its mode of weathering. Partly because of a somewhat concretionary nodular character pervading the whole of the rock, but more on account of the readiness with which it yields to the action of carbonated water, so that every little temporary growth of moss or lichen begins the work, and we find all over exposed surfaces pits, like old worn pholas borings or small joints, invisible in the newly broken rock, but picked out by the weather so as to look at first like glacial grooves, but soon opened out into great scars. Combinations of all these kinds of weathering, on a larger scale, give us caves, which sometimes appear to run into solid rock like enormous pholas borings; at other times these caves obviously follow the pre-existing fissures and joints.

Extensive tracts of limestone are weathered along the bedding planes, and flake off in slabs from a few inches to a foot in thickness, which are eaten out into round holes or sinuous openings, so as to take all sorts of fantastic forms. These are much sought after for ornamental rock work. They may be well studied on the wooded limestone hills N. of Denbigh. On the smaller phænomena of pitted surfaces have often been founded theories of submergence to explain the supposed pholas borings, but a careful study of their manner of occurrence will show that, although they do exactly resemble weathered pholas borings, they are most commonly produced by the action of rain-water, helped by the additional carbonic acid derived from the atmosphere and from decaying vegetation. On the Orme's Head they may be seen in parallel vertical bands, running down the cliff for 40 or 50 feet, where the drip of water from above has kept up a dotted growth of vegetation, while on the intermediate dry portions there are none. The cliffs have been perishing too rapidly to allow of the possibility of these pits having been there since the last submergence, nor could we even on that hypothesis explain their continuous occurrence for such a height, except we suppose the emergence to have gone on so rapidly that the lower ones were being formed after the upper ones had been raised above the level of the sea, and yet that they kept up the arrangement in parallel vertical bands.

In the quarry between Pontnewydd and the cave now known by that name, there is a band of red clay, chiefly the earthy residuum of the decomposed limestone, drifted into the opening fissure between two beds of limestone. The under surface of the upper bed is pitted with holes like those made by pholas weathered out. Here it is impossible there can have been any lithodomous molluscs. The opening out of the joints on a small scale so as to produce fine lines like glacial striæ is well seen in the quarries N. of Tyddyn Uchaf, N. of Denbigh, and the larger gaping fissures, running straight on for many yards, due to the weathering along master-joints, may be well seen over the top of the same hill.

Nowhere have I ever seen such a curious imitation of bedding produced by infiltration bands as in the sandy flaggy beds of the Craig Quarry, near Denbigh. The rock is generally of a buff or grey colour, and the bands are of a darker tint approaching black. They are seen following the joints all round near the margin of the slab, but rounded off as they get further in (fig. 10.)

A fragment broken off the side of the slab would certainly be taken for a laminated rock, in which the bands of colour indicated difference in lithological character, due to original deposition. Similar phænomena, but not so well marked, are not uncommonly seen in the Silurian flags. In one locality in Yorkshire all the débris on the hill side consists of flat stones, ringed and banded in purple and red. These rocks, which are known as the "Moughton Whetstones," are of exactly the age of our Denbigh Flags and Grits, which frequently exhibit the same markings, where they occur near the base of the Devonian, as seen E. of St. Asaph or W. of Denbigh in many places.

FIG. 10.

Slab of Mountain Limestone, showing the bands produced by infiltration from joints, Denbigh. (Scale, 2 feet to 1 inch.)

THE NEW RED SANDSTONE.

It will be seen from the above observations on the Carboniferous Rocks that the area of the New Red will have to be reduced considerably when we have taken out all the stained Carboniferous, and, as these were the only variable beds, what remains requires no long description, for it agrees with the great masses of New Red in other districts, in consisting of an enormous deposit of red sand of very uniform texture all through, and quite unfossiliferous. Aveline (Expl. Hor. Sect., Geol. Survey, Sh. 43.) says—"The New Red Sandstone in the Vale of Clwyd is believed to be that subdivision known as the Lower Red and Mottled Sandstones of the Bunter Series. It lies quite unconformably to the rocks beneath which have been disturbed and denuded before it was deposited, and thus, as may be seen by referring to the map, it rests indifferently on the Limestone, the Old Red Sandstone, or the Silurian Strata. * * * The structure and composition of these sandstones are much the same throughout the Vale; and in sinking a well at Ruthin, to the depth of 400 feet, the same kind of rock was found from top to bottom. It is a soft, false-bedded sandstone, of a red brown, or brownish red colour." (See also Ramsay Mem. Geol. Survey, Vol. iii., p. 228.) The quartz grains are only coated with the iron oxide, but this is not easily removed altogether, as may be seen by the red colour of the drift sand derived from it. When, however, the colouring matter is destroyed by chemical action, the sand is found to consist of grains of pure white quartz, much of it being clear.

We have at the base of the New Red the second great geological break in our district. Just as, in speaking of the base of the Carboniferous, we had to point out that the Silurian Rocks, and a great series, the Lower Old Red, which regularly and conformably succeeded them, were upheaved, and all the higher ground was washed away by rain and rivers, and perhaps frost and ice, and the sea cut back the cliffs, and planed off the ancient continent, and then the land went down again, and the Carboniferous Rocks were formed in a gradually sinking area, where silting up nearly kept pace with submergence, so that sometimes we get a filled-up estuary with drifted wood and fresh or brackish water shells, and at other times find that the sea has rushed in with its brachiopods and even corals. So now we have to tell exactly the same story over again; the Carboniferous Beds, and the still more ancient rocks which formed the floor on which they lay, were all lifted up, and the rain and rivers, and frost and ice and sea, again began their work, in places even stripping the Carboniferous away, and exposing the old Silurian, much, if not all of which had been covered up by the newer deposits. Again there was dry land over our district. What was that old land-surface like? As before, we get for answer that there is very little can be made out about it.

Perhaps we may notice that we have more evidence of limited hydrographical areas at the commencement of the New Red than during the early part of the Upper Old Red Epoch. We find at the base of both traces of valleys and of subaerial waste, but at the base of the Upper Old Red, or Devonian, we find more evidence of marine denudation as well. In both cases we find in some other areas tremendous banks of shingle marking the shore of an encroaching sea. But in our district, although we are on the edge of a mountain land, it is curious how often we find that there is little or no conglomerate at the base of the New or of the Old Red along lines of what must once have been shore. I think the explanation of that may be that the part now exposed is some way up the ancient mountain slopes, and that the conglomerate has got drifted further down into hollows.

It is a noteworthy circumstance that when the Mountain Limestone rests on the older rocks, without the intervention of the Upper Old Red, corals are seen growing on the boulders that lay scattered on the sea bottom. So when the calcareous beds of the Jurassic group rest on the older rocks, without the New Red, they are highly fossiliferous. When, however, the Upper Old Red, which is the basement series of the Carboniferous, rests on the Silurian and pre-Silurian land, we find hardly a trace of life; and so when the New Red, which is the basement series of the Jurassic, rests on the Carboniferous and pre-Carboniferous rocks, we have the same absence of evidence as to the life of the epoch. We know that queer fish swam in the waters in which the irony deposits of the Old Red were thrown down, and we know that queer reptiles, like enormous toads, walked on the shores of the waters in which the somewhat similar beds of the New Red were formed. But how little else we know of the life of either period, and in our district we have collected as yet hardly any evidence at all.

Sometime after that our mountain land came up again. Whether it was rising during the long period when the Jurassic Rocks were being formed in the sea that washed its eastern shore, or whether the movement of upheaval took place chiefly in that time of known disturbance, when the Neocomian and Cretaceous sea advanced over the denuded edges of the Jurassic beds; whether some tributaries of the Wealden river brought sediment down Welsh valleys; whether some of the lumps of coal found in the chalk may have come from Ruabon; whether the igneous, metamorphic, and Silurian Rocks found in the Lower and Upper Greensand may have been carried from the mountains of Wales, or from ancient ridges now covered up or still exposed elsewhere, we have not at present internal or external evidence enough to show. We have not in our district, nor among the Welsh hills anywhere, any deposit of oolitic, cretaceous, or of any later date, until we come to that wonderful time known as the Glacial Period. Just beyond the mountains of North Wales, on the southern borders of our district, there is a small patch of Lias, to which the attention of the Society has been called by PROF. JUDD. So also near Cardiff, in South Wales, we have a small patch of Lias, with the passage beds from it down into the New Red. Just enough in both cases to remind us that we have in the New Red only the conformable basement beds of the Jurassic.

The character of the New Red may be well examined in a quarry by the Clwyd, below Llanerch, and in various sections near Ruthin. The base is rarely seen. In the narrow valley behind Llanrhaiadr it seems probable that we must be very near it, but faults obscure the section.

In the bed of the stream which runs down by Pontcerrig and Pentre, from Rhydganol, the junction of New Red and Silurian is seen in places to be a fault, but on the upthrow side some New Red seems to be still left resting on the Silurian. The Silurian is much decomposed, and deeply stained red and purple. The decomposition splits it up along the mica layers, so that it sometimes looks like a flaky Devonian.

In the New Red are lines and lenticular beds of conglomerate, composed of limestone pebbles, probably derived from the Mountain Limestone, which occurs not far off. It is then much like the brockram of the Eden Valley; at other times the fragments are all of Silurian. The ground is steep and rough, and the denudation rapid, so that the section varies much from year to year, and the small lines and bands of conglomerate cannot always be seen.

FIG. 11.

Section near old quarry opposite Cilowen, St. Asaph.
(Scale, 4 feet to 1 inch.)

a. False bedding.
b. Pebbles in fissures running obliquely to face of rock.
c. Joints.

I have known some curious cases in which one might be deceived by the accidental occurrence of pebbles, which have got in along lines of fracture in the rock. For instance, in a cliff near Cilowen, near St. Asaph, in which the rock consists of a false-bedded, homogeneous, softish red sandstone, crossed by two principal sets of joints (see fig. 11.) Down the middle of the section, and partly following the joints, runs what appears to have been a small open fissure, which has got filled with nests and lines of pebbles. These sometimes strike off into the lines of bedding, where they look exactly like contemporaneous conglomerate; but they do not follow it far enough to lead one to think that they were all derived from, and originally belonged to bands of conglomerate in the New Red. The pebbles are all such as might be derived from the Grauwacke (Silurian and Cambrian) to the West. They are flat pebbles, varying from 1½ inch diameter down to sand. There are broken pebbles, and a few angular fragments. Quartz occurs but rarely.

The real explanation is that the principal fissure runs just behind the surface, being inclined at a small angle to the face of the rock. So that as the face of the rock gets cut back, the debris in the irregular fissure gets exposed, and the irregularities of the fissure coincide generally with the bedding and cross joints.

OLDER PLEISTOCENE.

GLACIAL.

First let us run over the main facts. On the hills all round the Vale of Clwyd striations on the solid rock are clearly seen in several places, always running in an easterly direction, generally a little N. of E.

Close to the cart track leading from Aclwyd Uchaf up the well-wooded hill known as Fron Haul, about 2 miles N.E. of St. Asaph, and running down the eastern slope near the top of the hill, the glacial groovings are clearly seen on the Silurian rock. They do not run down the steepest slopes—their general direction being E. 10° N. On the limestone behind the stables at Cefn the striations are seen running in an E.N.E. direction on rock which dips S. 10° E., and have been preserved under a small covering of reddish clay, with small rounded fragments chiefly of Silurian ; but there are also some pebbles of granite, &c., which, with the texture and colour of the mass, lead us to refer it to the Clwydian marine drift.

At the S. end of the Vale on Bryngorlan the striæ run easterly, some a little N., and some a little S. of E. I know of no striæ running down the Vale of Clwyd. The ice ignored it altogether, and ran across it almost at right-angles to the direction of the valley. If we wander beyond the Vale, E. or W. or S., we find the same thing. In many places along the coast of N. Wales, the striæ, instead of running down to the sea, are parallel to the coast line. The striæ on Caer Drewyn, near Corwen, and near Nantbach below it, run a little N. of E. On Hope Mountain the glacial grooves run towards the great Cheshire plain, turning rather S. of E., while a little W. of Holywell they may be seen running in a north-easterly and south-westerly direction, but it is not clear whether from N.E. or S.W.

It may be that the ice from the eastern slopes of the Welsh Mountains had to go east on to the Cheshire plain because the way north was blocked by ice from the Lake District. This would mean that there was one continuous mass of ice from Snowdon to Scawfell, and that a great confluent stream crushed its way over Chester on to the plain beyond.

When we get into the high mountains there are obvious traces of glaciers (see Ramsay Glaciers of N. Wales.) There small glaciers belonging to a later period left their mark in almost every valley—but there is no evidence that there ever was a glacier travelling down the Vale of Clwyd—so that the marks of the great ice that came from Arenig and Snowdon were not obliterated by any small glacier of later times, when the conditions no longer allowed the Snowdon ice to reach so far.

During the period of extreme glaciation all was covered by ice, and we could not have any fauna or flora in our district. If few peaks stood above the ice, but little material could fall on it, only just enough to act as a rasp on the underlying rock, for ice with no stones in it could not do much scratching work. The few stones that did get on it would soon be swallowed up in the crevasses, and be rolled and polished and scratched against one another and the rocks over which the glacier passed. So this must have been the time when the far transported boulder-clay was formed, with few stones in it, but most of those glaciated.

Of this we cannot expect to find traces in our district. It was carried to the ice-foot far away. But when the climate became milder, as the land went down the ice receded, leaving at successive stages glacial débris varying as time went on and the conditions changed. Still a large number of stones would be carried from the Welsh mountains, but a smaller proportion of these would be glaciated New peaks would continually stand out from the shrinking ice, and lines of boulders from them would be found. To this period we must refer the blue boulder-clay with felsites and other igneous and metamorphic rocks. Such as that in the Elwy valley, near Dol, or that at the bottom of the cutting made for the reservoir at Llanefydd (see fig. 12.)

FIG. 12.

Section seen in cutting made to procure clay for reservoir at Llanefydd.

a.	Peat, with timber a foot in diameter	3′
b.	Gravel and sand, such as might belong to stream now running down the valley; clay with rootlets	4
c.	False-bedded and irregularly curved beds of sand and gravel; very ferruginous in places; lines of clay (perhaps only older and deeper beds of *b.*)	10′
d.	Very fine pale chocolate clay, sometimes laminated; cut off very irregularly by lines and beds of black shiver and sand. This bed passes in places rapidly into *e.*	10′
e.	Blue clay, with fragments of stone, few of which are striated; most of the rocks are of local origin	10′ to 20′

NEWER PLEISTOCENE.

The sea soon followed the receding glaciers over the sinking land, and now our evidence becomes more clear. For though the temperature was still low, the sea was full of life, and shells were thrown up in the sand and shingle along the shore, and have been preserved in many places. Here we must bear in mind that the very existence of great masses of ice in the neighbourhood must reduce the temperature, so that if there were mountains high enough to have snow all the year round, or even glaciers, in North Wales now, although the other conditions which affect climate might remain the same, still it would be very much colder on the coast of North Wales than it is. Provide conditions that will bring glaciers down to within a few feet of the sea, then the existence of the glaciers themselves will cause such a reduction of temperature that they will get to the sea, and *vice-versâ*. So when things began to go against the glaciers they probably receded fast, and the sea first rolled in over ground it might have covered before had not the ice advanced to meet it far off shore. To this state of things we must refer the mixed drift, which sometimes contains great masses of boulder-clay unsorted by water, and sometimes stratified sand and gravel, and this is properly the end of the Glacial Period. The sea worked away at the old glacial deposits along the hill sides, and in the Vale of Clwyd used up much of it to form the Clwydian Drift.

If the great ice-sheet was long stationary, it must have left a great morain, but we do not find any such thing, so we infer that when the ice began to recede it did go back steadily, and any small moraines which had been formed were washed away by the sea.

Now we must examine the composition of the Drift of the Vale of Clwyd, which from its general character I would refer to this period, *i.e.*, the period of the encroachment of the sea immediately upon the recession of the glaciers.

Which part belongs to the encroaching sea during the period of submergence, and which to the receding sea as the land came up again, I have not evidence strictly to define. The period of submergence, being essentially one of accumulation, should be marked by heavy deposits of clay as well as sand and gravel. Whereas the period of emergence, during which the shallow water conditions come into operation last, is more especially a time of destruction and winnowing out of the softer deposits brought within the action of the sea waves. The results we should expect to find in sand and shingle and broken shells. Though it would be difficult to map them out it is clear that there are two drifts in the Vale of Clwyd. The older consisting chiefly of clayey deposits, with none but rocks from the Welsh hills; the newer being a drift in which local débris bears a larger proportion to fragments from the Welsh mountains, and containing also a great variety of rocks which seem to have come by sea, viz., Scotch granite, Lake Country rocks and flint, with numbers of broken shells.

The clays and sands in the Vale have generally a purple tinge derived from the New Red, which furnished a large part of the sand, or sometimes perhaps derived second-hand from the red-stained Carboniferous Rocks. This colour does not generally affect the gravel, and does not often extend much beyond the Vale itself. For instance, the gravel of Talargoch is grey, and, though a red sand occurs in the gorge of the Elwy fairly round the corner by Dolben, yet the clay and gravel drift immediately beyond by Dol, and on the hill-top by Bryn-y-pin, is not stained. In all this division of the drift flint occurs. The occurrence of flint, is, I should say, for this area the most characteristic feature of the deposit. It is not flint ice-borne from chalk, but rolled gravel-flint often with the ferruginous rusty gravel-stain remaining. It looks as if it must have travelled on shore ice, or with some shore-travelling shingle, when the submergence allowed currents from the east to run through by Chester.

To this stage I refer the Macclesfield beds and the Moel Tryfaen beds, and the greater part of MR. SHONE's Cheshire Drift, all of which contain flint. Among the other included fragments we have of course samples of almost all the rocks of the Welsh mountains from which came the great ice that left the easterly striæ, but we have also Criffel granite and St. John's

Syenite, and many other rocks igneous and metamorphic, which are more likely to have come from the Lake District and Scotland than from their Welsh geological equivalents.

Then as to the palæontology of the beds—looking at MR. SHONE'S list of shells from the marine drifts of Cheshire (see Quart. Journ. Geol. Soc., Vol. xxxiv., p. 383,) and at MR. GWYN JEFFREYS' list of the shells of Moel Tryfaen (see Quart. Journ. Geol. Soc., Vol. xxxvi., p. 351,) the shells I have as yet found in the Clwydian drift (see p. 29,) even allowing for the difference in the number of species obtained, would seem not to indicate quite so cold a climate. Perhaps the area examined by MR. SHONE was submerged more early than the Vale of Clwyd, and before the ice had receded so far, and was more chilled by floating ice from the North—while the Moel Tryfaen shore, from proximity to the great mountains, would also in all probability be longer affected by the chilling glaciers.

The valley of the Chwiler, or Wheeler, inosculates with that of the Alyn, which flows into the Cheshire plains. On the flanks of the hills there is a stiff boulder-clay probably of early glacial age; but all along the valley, in great mounds and ridges, there is a red sandy deposit which it seems pretty clear belongs to the marine Clwydian drift, when the sea had taken the place of the glacier ice and was swilling up and down through the strait. On the other side of the Vale the same kind of sand and clay is seen in the river cliff below the road from Pont-yralltgoch to Wigfair, and fragments of shell, chiefly *Tellina balthica*, are not uncommon. The principal section, however, is in the river cliff near Brynelwy, where there is a mass of gravel, sand and boulder-clay now somewhat confused by landslips, but still furnishing evidence of the occurrence of a reddish boulder-clay above, sand and gravel in the middle, and grey or blue boulder-clay below less clearly seen. Shells and flint occur all through the two upper divisions. In the gravel and sand I found balls of reddish clay with Silurian fragments only included in it, but with the outside stuck all over with sand and gravel similar to that in which it was imbedded. This was evidently a fragment of an older boulder-clay formed not far off. It had the purple stain of the New Red, and had been rolled along the shingly shore in the sea in which the Clwydian Drift was deposited, just as I have seen the sea rolling balls of boulder-clay along the shore at Colwyn, and near Penrhos in Anglesea, or balls of London clay in the Isle of Sheppey. Those all had fragments of stone and shells stuck over the outside till they looked like pebbles of conglomerate.

In the reddish boulder-clay well scratched stones occur, but one fragment I found which showed that the stone had been broken up after it had been glaciated. Probably it had been exposed in a cliff of ancient boulder-clay which was being denuded, and the stones in it were shivered by the frost or sun.

Everything fits in with the hypothesis that the mixed Clwydian Drift belongs to a period when the glacier ice had receded, and the sea was working away at sorting and transporting the ancient glacial drift and mixing it up with the shingle travelling along the shore, and perhaps some débris borne by shore ice from the north and east.

What was the extent of the submergence which followed the Glacial Period? If I am right in referring the gravelly drift about Bryn-y-pin and the granite boulders along the top of the ridge south of Fronhaul to this period, then the sea must have rolled over the bounding hills on both sides of the valley. How much deeper they went we cannot say, but this is not nearly so great as the known submergence of 1,350 feet on Moel Tryfaen, or even of 1,250 at Macclesfield.

I will now call attention to some other sections in which the details of these drifts may be studied.

It is well developed at the west end of the estuary about Colwyn (see fig. 13.)

FIG. 13.

Section in promontory, about 200 yards N.W. of Bath House, Aberrhyd, Colwyn Bay. (Scale, 20 feet to 1 inch.)

a. Chocolate-red clay, with scratched stones.
b. Sand.
c. Yellow laminated sandy clay.
d. Blue clay with scratched stones.

In the Limestone Quarry near last "r" in Parc-y-milwr, near Abergele, there is a great mass of sand and gravel which I would refer to the Clwydian marine drift. It consists of angular, sub-angular, and rolled fragments of carboniferous and grey rocks, and abuts against an irregular cliff of Mountain Limestone.

In the valleys of the Elwy and the Clwyd, we find the same drift exposed in many natural and artificial sections (see fig. 14.)

FIG. 14.

Section seen in east bank of Elwy below The Mount, St. Asaph. (Scale 40 feet to 1 inch.)

a. Marine drift with shells—*see list.*
Consists of alternations of brown or red clay and loam with beds of sand and gravel. Varies much from year to year as the river cuts back the cliff. Generally the middle part is distinctly banded with alternate more sandy and more loamy beds. Scratched stones not common. Flint and granite as well as boulders from Welsh hills.
b. Blue clay with many scratched stones. Boulders all from Welsh hills except in top part.

A similar section is seen in the river cliff S. of Brynelwy, near St. Asaph.

The shells are almost all broken, generally only small fragments remain. *Mangelia*, however, I have found perfect, and *Turritella* nearly whole.

All occur, and all but two are common on the coast only five miles to the North of St. Asaph.

The following is the list of those found within a mile of St. Asaph, along the west slope of the hill on which the Cathedral stands:—

Dentalium abyssorum or *tarentinum*	*Artemis exoleta*
Littorina littorea	*Astarte borealis*
Trophon clathratum (= *T. truncatus* = *Fusus Bamffius*)	*Cardium edule*
Pleurotoma (Mangelia) rufa	*C. echinatum*
P. turricula	*Mytilus edulis*
Turritella terebra	*Ostrea edulis* (young)
	Tellina balthica

In the Llanerch brick pits a mottled blue-grey and purple clay is worked to 7 feet. The workmen informed me that it extended much further down but got too strong. Even the surface part which was being worked was too strong for making bricks. A few worn stones occurred either singly or more commonly in little groups here and there. It looked to me like the Clwydian clayey drift sorted and carried away from the stones, a part of which got floated out perhaps on shore ice. Hummocky patches of this drift occur all the way up the valley. The following rather curious section was exposed near Llanrhaiadr (see fig. 15.) I do not know whether the upper and lower part of the deposit should be referred to the same conditions.

FIG. 15.

Section in Clwydian Drift near Pandy, about one mile S. of Llanrhaiadr. (Scale 20 feet to 1 inch.)

a. Coarse gravel in which some pieces of red sandstone have lost all the colour and, flaking along the lines of original stratification, present somewhat the appearance of nearly vertical false bedding, and explain the origin of much of the included sand.

b. Grey sand with red bands, lumps and lines of reddish clay, buff loam, and gravel in thin finely false-bedded layers; the layers strongly picked out by the alternations of colour.

On the West of the Elwy, on the road from St. Asaph to Wigfair about ¼ mile S.W. of Glanllyn, near where the second "y" in Ffynon-y-Capel is engraved on the Ordnance Map, there is a fine section in the Upper or Clwydian drift (see fig. 16.)

FIG. 16.

Section seen in Cliff near Wigfair, St. Asaph.

a.	Brickearth	8′
b.	Reddish boulder-clay	25′
c.	Red sand	25′
d.	Greyish boulder-clay; some stained red ..	50′
e.	Inferred position of solid rock.	

The bed *(a)* exposed in the road cutting is a kind of ancient rainwash loam, fine and homogeneous, and much frequented by wild bees.

On the opposite side of the road there is a steep cliff of drift generally bare of vegetation nearly down to the mill race. The bottom of the cliff for about 50 feet is less well exposed, as the talus accumulates near the base, and I do not know whether the lowest part should not be referred to the older or Welsh Mountain drift. In the upper part a few fragments of shell occur here and there. The rock is nowhere seen, but it occurs at the level of the base of the cliff on the other side of the valley.

Higher up the valley of the Elwy, the red sand of the Clwydian drift is seen in a small section above the cottages at the bend of the river below Dolben; and still higher up the gorge, at the bend of the river near Dol, there is a very fine section in yellowish sand associated with reddish boulder-clay, which must all be referred to the Clwydian drift (see fig. 17.) It rests on blue boulder-clay, probably the older or Welsh Mountain drift.

FIG. 17.

Section of River Cliff near Dol, Valley of the Elwy.

a. Black peaty silt and clay.
b. Reddish boulder-clay.
c. Sand.
d. Grey boulder-clay.

The beds *a*, *b*, and *c*, have slipped over *d*, and probably may not here occur *in situ* quite at the bottom of the valley, but their relative position can be made out from an examination of the whole section. The peaty bed on top probably belongs to some pond in surface of the drift which has slipped with the rest.

The marine drift of the upper part of this hill was probably continuous with that by Bryn-y-pin, and belongs to the Clwydian series.

Down the road between Wern and Pen-y-banc, N. of Pont-yrddol, there is a grey gravel and here and there beds of sand. It was all, as far I could see, composed of Silurian and Cambrian rocks, and seemed to belong to one of the later ages of denudation.

At the east end of the estuary it lies on the flanks of the limestone hills about Dyserth, where mining operations have proved it to 170 feet in places—Figs. 18-19.

FIG. 18.

Diagram Section Talargoch, Dyserth. Oct. 7, 1875.

a. Mountain Limestone.
[Millstone Grit is shewn on Survey Map, but I could not verify its occurrence in this section.]
b. Marine gravel, sand, and clay drift. The details of this part of the section are given in Fig. 19.
c. Lode.

The limestone had been peeled off along the bedding planes, and the sand and gravel generally abutted immediately against the face of a bed. I was informed that lumps of ore had been found in the lowest bed close to the surface of the rock. This looks as if it had been washed off an ancient land surface and had been sorted according to its specific gravity along shore. In the gravel from top to bottom were fragments of felstone, felspathic breccia, and a kind of granite. The far-transported rocks are all rounded. The fragments of mountain-limestone are often angular. The waterworn pieces of limestone are frequently perforated by boring organisms, as we now find similar stones on the shore at Rhyl. In the upper part, which abutted against the limestone in the railway cutting close to Talargoch office, I found fragments of *Tellina solidula*. MR. SMITH, the manager, informed me that he had heard of stag's horns being found in the lowest beds. This was probably a tradition of the stag and mammoth referred to by BUCKLAND (*Reliquiæ Diluvianæ*, p.p. 177-8.)

FIG. 19.

Sir Edward Walker's Shaft, Talargoch. (Scale 40 feet to 1 inch.)

a.	Surface soil	1′ 6″
b.	Marl and clay	21′ 0″
c.	Dry sand	10′ 6″
d.	Quick sand	30′ 0″
e.	Strong Clay	6′ 0″
f.	Sand and Gravel	18′ 0″
g.	Gravel	6′ 0″
h.	Clayey gravel with water	30′ 0″
k.	Sand and gravel	36′ 0″
l.	Gravel with lumps of ore at base.. ..	12′ 0″
m.	Mountain limestone followed along lode.	

"PENNANT mentions two molar teeth and a tusk found in Flintshire, at Halkin, near the mouth of the Vale of Clwyd"—BUCKLAND, *Reliquiæ Diluvianæ*, p. 174.

"The remains of elephant which I have mentioned as being found in North Wales, in the Vale of Clwyd and near Dyserth, are attended with some peculiar circumstances: they are commonly said to occur in a lead mine, and so in fact they do; but it is a lead mine of an unusual kind, being conducted in a bed of diluvial gravel, that contains pebbles of lead, as the gravel beds of Cornwall, called stream works, contain pebbles and sand of tin ore." "It is the only case I know of in this country where lead is found under such circumstances in sufficient quantity to be worth working. It is locally called flat ore, from its occurring in flat or horizontal beds of gravel. Its occurrence here is explained by the position of this gravel bed at the mouth of a valley of denudation, cut in the limestone hills of Halkin, which are full of lead veins. The gravel resulting from this destruction contains fragments of lead ore, mixed up with the wreck of the rock that formed its matrix before the excavation of the valley. Its thickness is unusually great, and several mines are worked in it; one, called Gronant Mine, gives the following section:

1.	Vegetable mould	2 feet.
2.	Clay, mixed with some sand and rolled stones ..	26 yards.
3.	Gravel beds, containing rolled pieces of lead of all sizes ..	8 yards.

In another mine, called Tal-ar-goch, the remains of ox and stag are found at present: and in 1815 a pair of stag's horns were discovered at 60 yards below the surface, and are now in the possession of the Earl of Plymouth at Tardebig. The section of this mine is:

1.	Vegetable mould	2 feet.
2.	Clay	26 yards.
3.	Sand and gravel	68 yards.

Containing pebbles of copper as well as of lead. Horns, teeth, and bones are found in it, at from 40 to 70 yards from the surface, and also at the bottom of the gravel, in immediate contact with the subjacent limestone rock.

Another shaft dug one mile south of St. Asaph, at a spot between the Elwy and the Clwyd, presented irregular alternations of clay and gravel, to the depth of 88 feet. For the above particulars, as to these lead mines, I am indebted to the kindness of C. STOKES, ESQ., and ROBERT DAWSON, ESQ."—BUCKLAND, *Reliquiæ Diluvianæ*, pp. 177-9.

Such is the record of the occurrence of mammoth and stag in gravel at the bottom of the Talargoch lead workings. The account simply enough states that the bones were found *in* the gravel, and those who refer all these deposits entirely to post-glacial times will not find it impossible to accept the statements. As, however, these observations do not seem to have been confirmed by further discoveries of bones in the Clwydian Drift, we are justified in asking how far it might be possible that such remains had worked down through fissures in the limestone at some later time, so as to appear to be associated with the lead-bearing gravels which abut immediately against the rock. We have not, it is true, yet detected the gravels of the earlier river denudation in the Vale of Clwyd, and may have to distinguish between many different river gravels by and bye; but this will not help us out of the difficulty, as I have shown that the Talargoch gravels contain sea-shells, and cannot be referred to any ancient river gravel.

If these bones do belong to the Clwydian Drift, their occurrence increases the probability of the deposit being post-glacial, and even connects it more closely in age with the cave deposits than we should otherwise be inclined to suppose. We must, therefore, seek for further information, and examine carefully any evidence of marine action in the caves.

It has been stated that sea shells were found in the Cefn Caves in such a position as would lead to the inference that they were introduced during the post-glacial submergence, but all the shells which I have found in these caves have been in cave-earth following the steep sloping floor as if carried in from above, and in no case in such a position or in such a deposit as would allow us to believe that they could have been washed in by the waves of the sea. It appeared to me more probable that they had been brought in by sub-aerial agency from the marine drift at any period subsequent to its deposition. We must have other evidence to prove that they were introduced by the sea.

A period of emergence is a period of destruction, and the record of such a period is to be looked for in the marks of denudation and not of deposition. So in our area, the present valleys of the Elwy and the Clwyd were cut out of the old estuarine deposits which we have been speaking of as the Clwydian drift, and which were once continuous from Bodelwyddan to Rhuallt, leaving between them the promontory on which St. Asaph stands.

CAVES.

The Cefn Caves have been long known, but the interesting fact that they contained the remains of extinct mammalia was found out by accident. The Rev. EDWARD STANLEY, walking up the picturesque valley of the Elwy, one day noticed a number of strange bones lying over the surface of the meadow land which lies along the river bank below the cliffs. They had been thrown there by MR. LLOYD, of Cefn, who was very sagaciously dressing his meadow land with the bone-earth from the Caves. STANLEY gave an account of the caves and their contents (Edin. New Phil. Journ., Jan. 1833. See also FALCONER Pal. Mem., II., 541; HUGHES & THOMAS, Journ. Anthrop. Inst., Vol. III., p. 387; DAWKINS' Cave Hunting, p. 286.)

In the year 1874 the REV. D. R. THOMAS and myself gave an account of discoveries made in the cave by the road leading from Cefn to Pontnewydd, *op. cit.*, in which, besides the remains of mammals mentioned in the list below, including one human molar, we found rude felstone and flint implements, all of which are now preserved at Cefn in the collection of MRS. WILLIAMS WYNN, who kindly afforded us every facility for investigation.

LIST OF ANIMALS FROM PONTNEWYDD CAVE.

Homo sapiens	*Meles taxus*
Hyæna spelæa	*Rhinoceros hemitœchus*
Canis lupus	*Equus caballus*
C. vulpes	*Cervus elaphus*
Ursus spelæus	*C. capreolus*
U. ferox	

At Plas Heaton, about 3 miles S. of St. Asaph, a most interesting cave is still being explored by the owner, MR. HEATON.

The remains hitherto found belong to Hyæna, Dog, Wolf, Fox, Glutton, Bear, Badger, Reindeer, Sheep, and Rabbit. Though the cave is probably, from its situation, one of the most ancient in the district, it is curious how few of the older group of animals have been found in it.

The earth had been much disturbed by badgers and other burrowing animals. The skeletons of two badgers and two large dogs were found together in one place, as if the dogs had worked their way down into the deep recesses of the badgers' earth, and in the terrible struggle which ensued the exit had got closed up, and all perished together. As I was standing behind the workmen, I was fortunate enough to pick up the jaw of a glutton which was thrown out from no great depth in disturbed earth. It was described by PROF. BOYD DAWKINS, Q.J.G.S., Vol. XXVII., p. 406. In a small crevice not far off, in the cliff below Galltfaenan, the remains of reindeer were found.

In the small *abris* at Brysgill, in the Elwy Valley, there were a few flint flakes and bone instruments of unknown date, but probably much later than the Palæolithic Period.

TRAVERTINE.

Closely connected with the weathering of the mountain limestone and the formation of caves is the deposit of stalagmite or travertine, the result of precipitation from the water which had helped to form the caves, when it came out again to the surface, and being aerated and losing its carbonic acid, had to let go its hold on the carbonate of lime which it had carried off from the cavernous rock. It is not of such common occurrence as one might have expected in a valley favourably placed for its formation and surrounded by mountain-limestone.

In the valley of the Wheeler there is an interesting section (see fig. 20) from which we can roughly estimate the age of the deposit.

FIG. 20.

Section behind the Inn, opposite the Railway Station, Caerwys, Flintshire. (Scale 40 *feet to* 1 *inch.)*

a.	Surface soil and rain-wash, derived chiefly from (*c*) ..	3′ 0″
b.	Travertine full of tubes and knobs, as if it had accumulated chiefly round plants, *Limnæa peregra, Helix caperata (?)* &c. .. .. .. to	15′ 0″
c.	Red sand with a little gravel. The included stones chiefly Silurian and Cambrian. Felstones rare .. (?) about	100′ 0″

The travertine seems newer than the red sand and gravel, and to have been deposited against a steep slope of it, as they dovetail into one another, and a little red sandy matter seems often to have been washed far out on to the travertine.

ALLUVIUM.

Where checked in its outflow the river Clwyd kept winding about and widening its valley till it opened out into the alluvial plain known as Morfa Rhuddlan. As soon as a good delta was formed the sand began to blow along the seaward margin of the alluvial deposits between tides, and dunes were formed, which effectually shut out all inroads of the sea. Within this later period it is probable that there were some slight oscillations of level, for all along the coast from near Rhyl to Colwyn Bay there are peaty patches, with remains of trees and roots, running into the blue scrobicularia clay. These run down to low-water mark, and, I am informed, still further out to sea. Hazel and birch are the common trees; and the antlers of red deer have frequently been found in the underlying clay.

Another change, which I think extremely probable, is the destruction of a headland of drift running out opposite Llandrillo-yn-Rhos. This would affect the denudation of the whole coast line, and with small oscillations of level; and the alternate formation and destruction of sand dunes would be quite enough to account for all the later changes at the mouth of the Vale of Clwyd.

In the wall of the churchyard at Abergele there is a plain sandstone monument bearing the following inscription:—

Yma mae'n gorwedd,	Here lies,
Yn monwent Mihangel,	In the churchyard of St. Michael,
Gwr oedd a'i annedd	A man who was born
Dair milltir yn y Gogledd.	Three miles to the North.

The churchyard is now only one mile from the sea shore; but the modern character of the letters, and the perishable nature of the stone do not permit of our assigning any great antiquity to the inscription. Yet it might be a late record of an old tradition, or a copy of an earlier slab. But the absence of any name or date, or mention of the circumstances make this improbable, as it could not be expected that posterity would take on trust an anonymous communication respecting a nameless person. Though it is true that the counties are curiously mixed up along the coast, and it has been suggested in explanation that portions now detached may have had continuous connecting land along the sea shore when first the boundaries were fixed, still this would not belong to so late a date as the inscription, and such a change of coast-line would have been a thing of so much importance that we should probably have heard more of it than an incidental allusion on a fanciful tombstone.

On the whole, then, it seems to me most probable that if the inscription be genuine and true, it is one of the conceits so common in epitaphs, and refers to a man who was born on board ship two miles off the coast.

The more recent estuarine deposits of Morfa Rhuddlan fill the valleys scooped out of the older estuarine and shore deposits I have been describing under the name Clwydian drift, against which it is sometimes found abutting. (See fig. 21.)

FIG. 21.

Section in ditch about half-mile N.W. of Rhuddlan.
(Scale, 10 feet to 1 inch.)

a. Surface soil.
b. Blue clay.
c. Gravel of angular and subangular and worn fragments in black smutty earth; looks as if there were burnt matter in it.
d. Gravelly drift. Sand and gravel with bits of red shale and clay (?) = Clwydian drift.

These newer deposits consist generally of a stiff blue-grey clay with subordinate silt and loam, and, in the upper part especially, lines and patches of peaty matter and trees (see fig. 22.) I saw no stones or shells in the clays exposed on the shore, except those which had evidently been driven in by storms and accident. There were stains and tubes of iron oxide, and many holes as if left by roots. The surfaces exposed between high and low water were perforated all over by boring molluscs.

FIG. 22.

Section seen in Marsh N. of Rhuddlan.
(Scale, 10 feet to 1 inch.)

a.	Surface soil.		
b.	Blue clay, weathering brown in upper part ..	..	1′ 0″
c.	Impure peat; no timber	..	0′ 6″
d.	Peat, with trees to 1′ 6″ diameter and 15′ in length	..	2′ 0″
e.	Blue clay	to	3′ 0″

The surface of this marsh is below high water mark.

I found broken shells of *Buccinum undatum* at base of (*a*); perhaps artificially carried there

Scrobicularia piperata, with valves adherent, occurred in (*b*), but I could not satisfy myself whether it belonged to the age of (*b*) or had burrowed into the softened surface at any later period.

In the Cambrian Inn, at Pensarn, are a skull of *Bos longifrons* and antlers of *Cervus elaphus*, said to have been found at a depth of 18 feet, in digging clay for making the railway embankment. There is also a fine pair of red-deer horns which was washed out of the clay in a storm. Some barnacles on one of the highest tynes show that it had projected through the clay for some time.

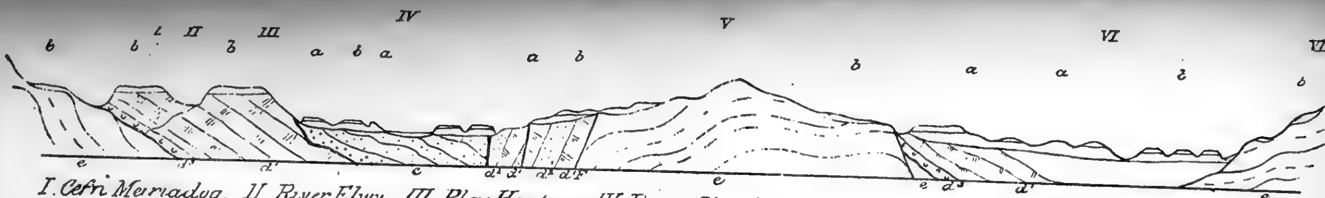
The blown sand and the shingle seem to travel over the surface of the Morfa Rhuddlan beds (see fig. 23) with the prevalent winds, chiefly from W. and S.W. to E. and N.E.

FIG. 23.

Section N.W. and S.E. across shore deposits, Pensarn, Vale of Clwyd.

a. Surface soil, recent alluvial deposits, &c.
b. Blown sand.
c. Shingle.
d. Blue clay.
e. Peat and trees.

Fig I



I. Cefn Meriadog. II River Elwy III Plas Heaton IV River Clwyd. V Shoulder of Moel-y-Gaer VI River Wheeler. VII. Moel y Parc.

Fig III.

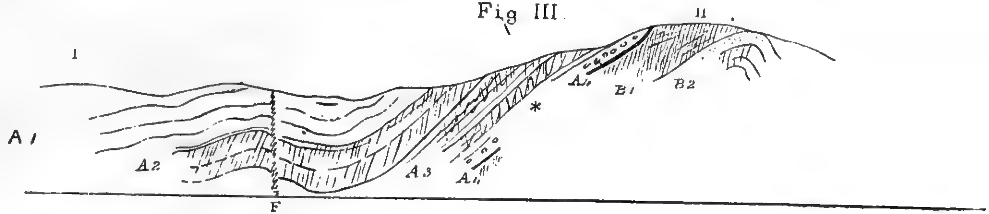
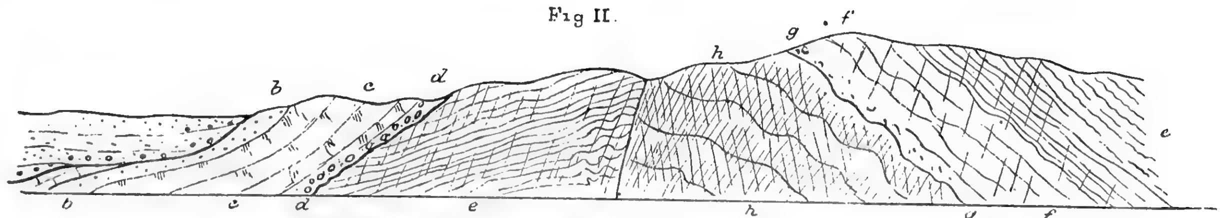
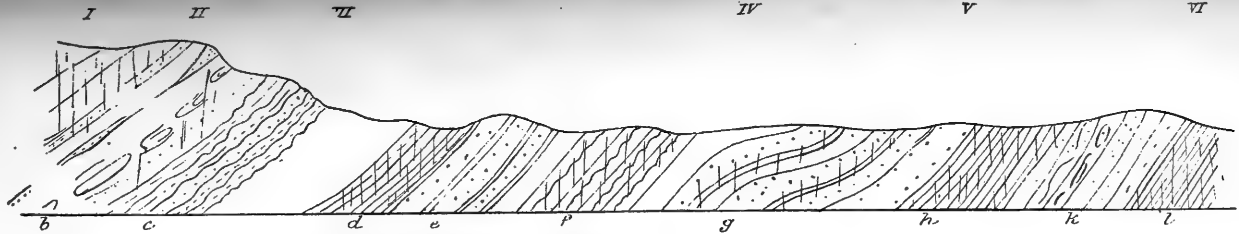


Fig II.



Section drawn N N W and S S E across the S. margin of the Clwyd valley near Llanfairdyffryndyd.

Fig IV.



I. Careg-y-gath. II. Moelgarol III. Cyfylliog. IV. Felin Moch. V. Pontuchaf. VI. Rhewl.

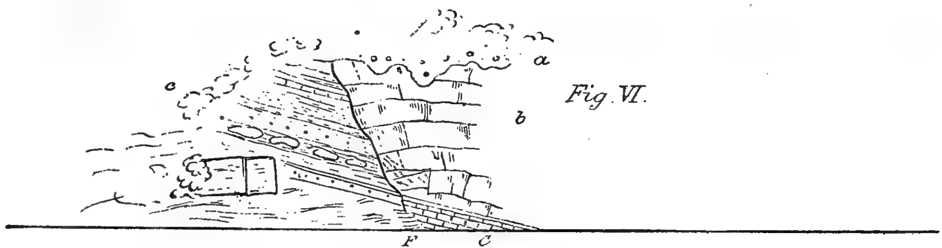
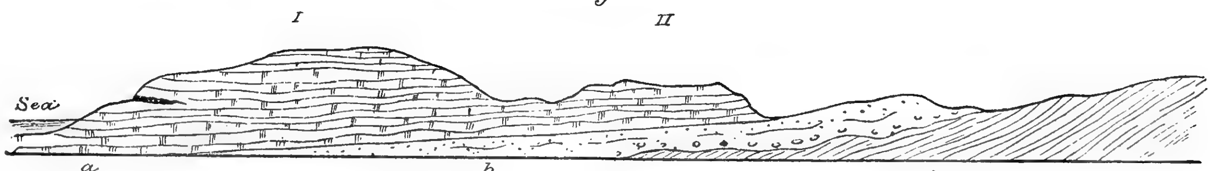


Fig. VI.

Fig. V.



I Toriad Gwynt. II Camp. 1 mile S.W. of Abergele.

Fig. VII.

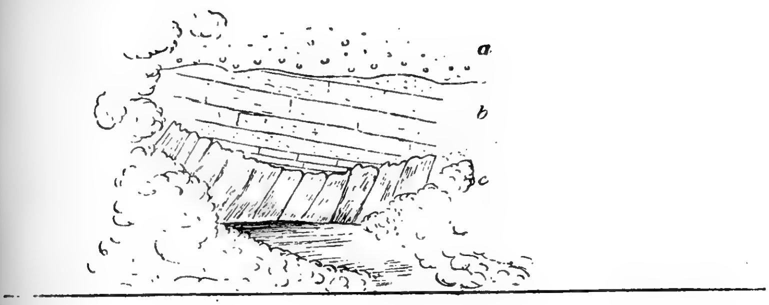


Fig. VIII.

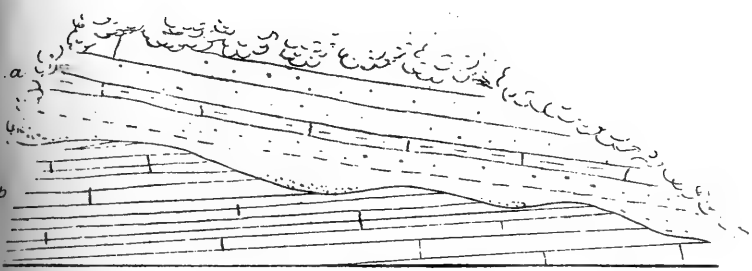


Fig. IX

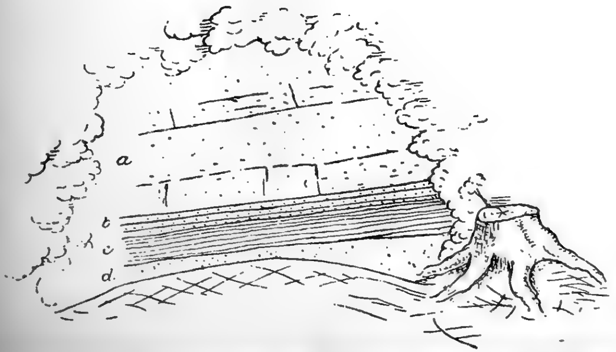


Fig. X.

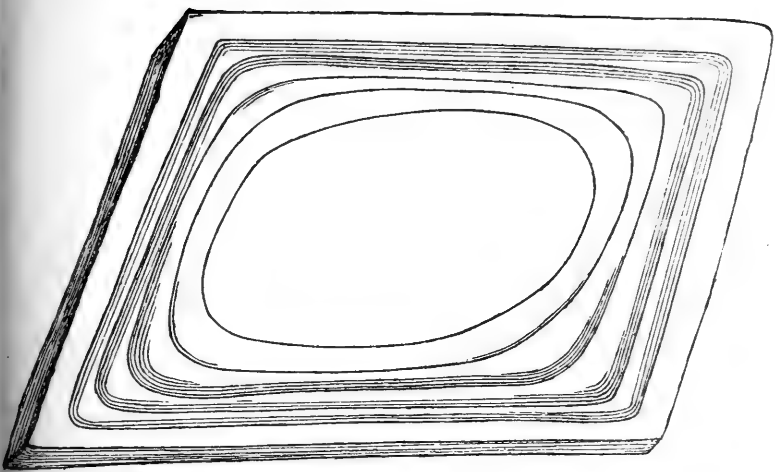


Fig. XI

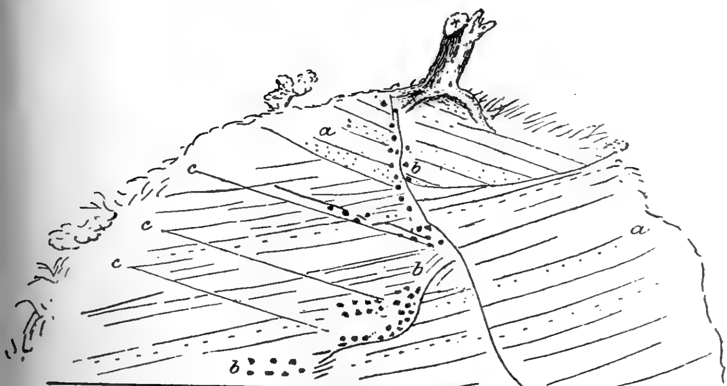


Fig. XII.

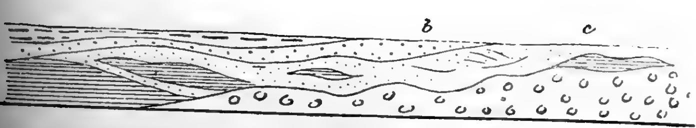


Fig. XIII

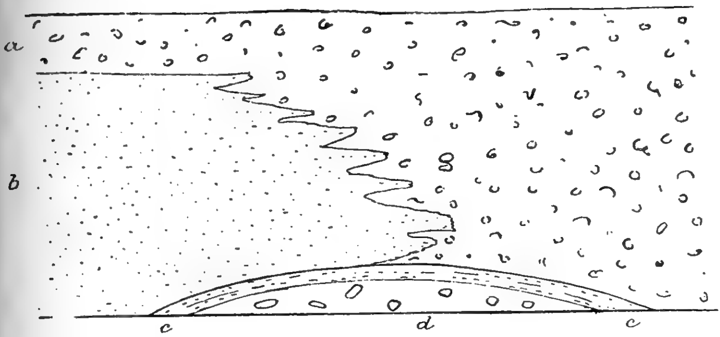


Fig. XVIII.

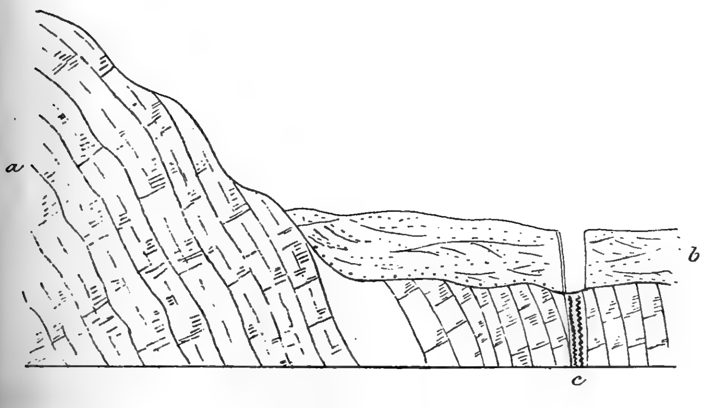


Fig. XIX.

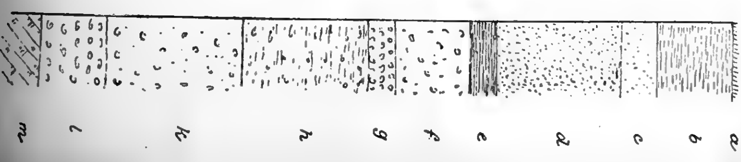


Fig. XIV.

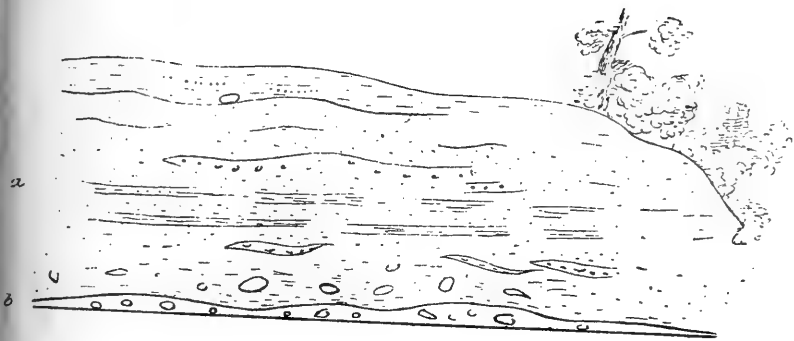


Fig. XVI.

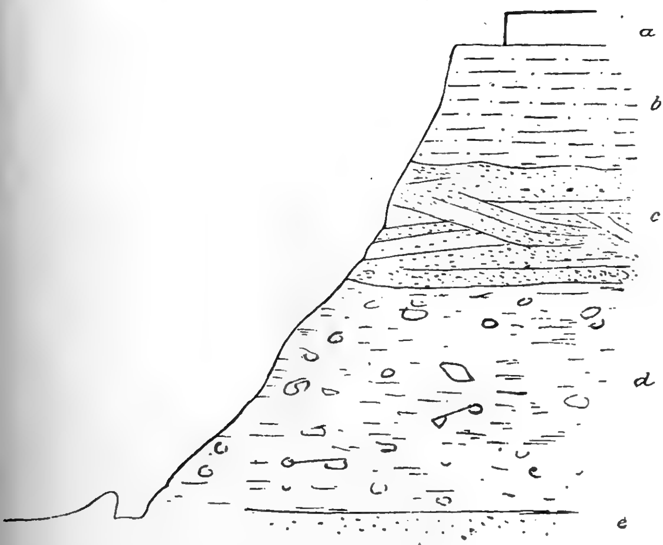


Fig XV

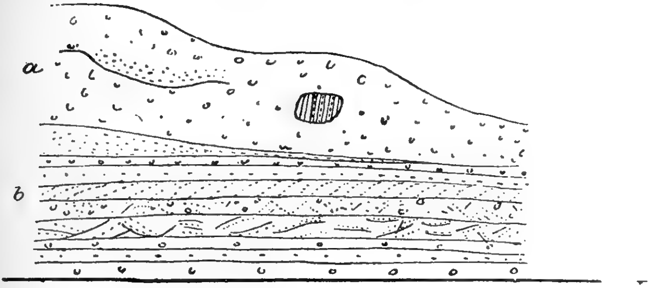


Fig. XVII.

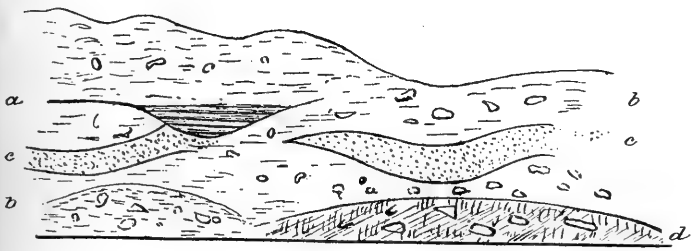


Fig. XX.

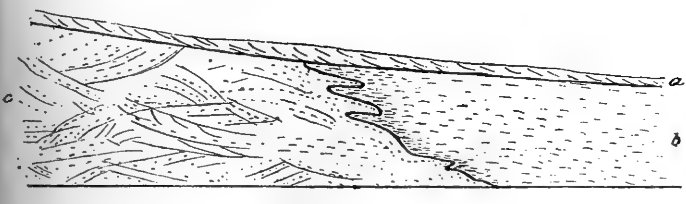


Fig. XXI.

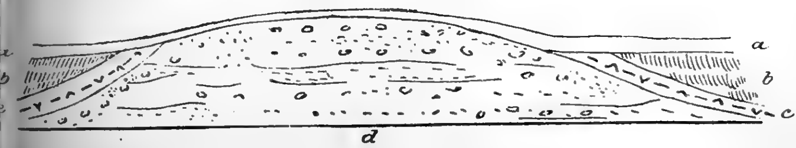


Fig. XXII.

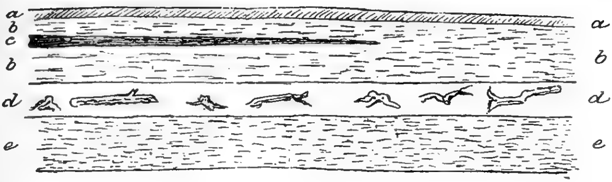


Fig. XXIV.

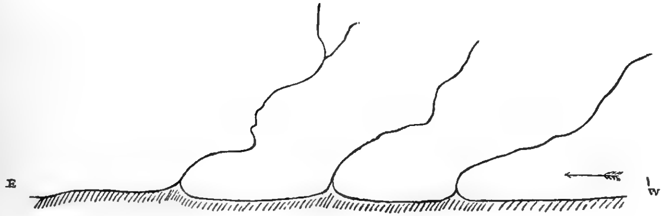
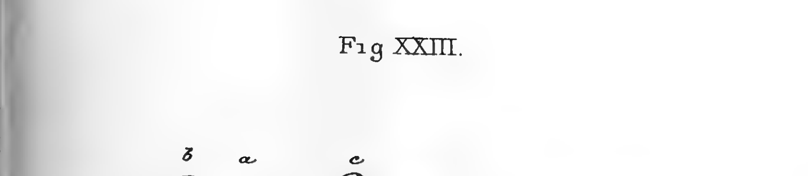


Fig XXIII.



The effect of this easterly drifting may be observed in all the little streams which run across the sand to the sea. They turn to the E. and N.E. as they get silted up on the W. side (see fig. 24.)

FIG. 24.

Ground plan of shore near Pensarn, Vale of Clwyd.

The blown sand and the shingle seem to travel over the surface of the Morfa Rhuddlan Beds (see fig. 23.) with the prevalent winds, chiefly from W. and S.W. to E. and N.E. The effect of this easterly drifting may be observed in all the little streams which run across the sand to the sea. They turn to the E. and N.E. as they get silted up on the W. side (see fig. 24.)

I do not know of any remains of man having been discovered in these beds, but they may yet turn up, as there are plenty in similar deposits elsewhere. We should find canoes, stone and bronze weapons, belonging to the later prehistoric races that we know lived on the hills around. The Pontnewydd cave folk lived ages before any of the silt and mud we are now describing was laid down. It was long after the main mass of the silt had been deposited, and while the estuary was now being cut back and now gaining again on the sea, that the Gweddelod and Ordovices (Gwyr Ardudwy) and other ancient tribes were struggling to hold the important positions along the north coast. The Romans marched aross it. The Saxons probably saw it. The English built the Castle of Rhuddlan on a bank of drift, along the base of which the Clwyd then ran. But here we are in the time of history. We have overlapped what might in one sense be called historic times, but the only evidence we have for that early part of history is geological. The fossils we dig up are stone and metal, and bone and wood, fashioned by man; but it is only by applying the methods of geology to the investigation that we can hope to arrive at any conclusion as to the sequence of events in those early times.

The Denudations of North Wales.

BY AUBREY STRAHAN, M.A., F.G.S.

A Lecture given on 24th November, 1881.

THERE are few districts which illustrate more forcibly than our own the fact that, while existing lands, being themselves chiefly formed of stratified marine material, occupy the sites of the seas of former geological periods, on the other hand these seas overspread the ruins of still more ancient continents. The cleaved and contorted, but purely marine Silurian rocks, the vast accumulations of shells, corals, and encrinites forming the Carboniferous Limestone, and the great half-marine, half-estuarine deposits of the Millstone Grit and Coal-Measures, form such records of the oceanic periods as can hardly escape attention; while the unconformity existing between these and the over- and under-lying systems proves, perhaps less obviously but not less conclusively, the intervention of continental periods, during each of which the deposits of the preceding age were elevated above the sea and exposed to denudation. My object is to examine the evidence on which these statements rest, and to shew how it may be obtained in the structure and mutual relations of the formations.

The earliest rocks in our own district are characterised by great volcanic activity. During the deposition of the Bala Beds great sheets of felspathic lava overflowed the sea floor, and showers of scoriæ and ashes were ejected, which, falling back into the sea, became stratified as they sank to the bottom and mingled with the remains of the sea-animals which were struggling for existence round the volcanic regions. As in the process of time these rocks were buried under later formations, the ashes were hardened, and cleavage, metamorphism, and contortion were produced. At a far later period, when the ceaseless movements of the earth's crust had brought the beds once more to the surface, there began to be carved out of them that endless variety of cliff and valley which is familiar to every visitor to Cader Idris and Snowdon. So great, however, is the amount of alteration and denudation which these rocks have undergone, that it is no longer possible to point even approximately to the position of any of the volcanic vents from which they were ejected, or to recognise in all North Wales a fragment of any volcanic crater.

At the close of the Lower Silurian period the volcanic outbursts ceased, and have not since been renewed. The great terrestrial movements which I am about to describe have been unaccompanied by any outward manifestation of volcanic energy in this particular region. And this, perhaps, seems the more remarkable when it is remembered that in most of the formations represented there were volcanic eruptions at no great distance ; in the Old Red Sandstone, for example, in the South of Scotland and in Ireland, and in the Carboniferous in the Isle of Man and North of England.

The Lower Silurian formations were succeeded naturally by the Upper Silurian, but at the close of the latter period the first great break, of which there is any evidence in our district, occurs. The great unconformity between the Carboniferous and Upper Silurian rocks is to be seen in many places, but perhaps nowhere better than in the valley of the Clywedog, near Ruthin. The red conglomerates which form the base of Carboniferous Series are here seen resting on the edges of the steeply upturned Silurian rocks, the bedding of the one nearly at right-angles to that of the other. It is clear that the Upper Silurian rocks were tilted up and largely denuded, either by atmospheric erosion or by the planing action of an encroaching sea before the Carboniferous Basement Beds were deposited upon them. But more than this; here as elsewhere the Silurian rocks are metamorphosed, and shew slaty cleavage, yet the Carboniferous shew neither the one nor the other. Now it is well known that these structures, which are due to pressure, probably accompanied by heat, are only produced at a considerable depth under a great thickness of overlying rock. Where such "cover" is wanting contortion may be produced, but not cleavage or metamorphism. At first sight it would appear as though the "cover" had been provided in the Carboniferous rocks themselves, which must, Coal-Measures and all, have once overspread all this area. That this was not so is proved beyond doubt by the simple fact that the fragments of Wenlock Shale which may be picked out of the base of the limestone and of the conglomerates, are as much metamorphosed as the parent rock itself, shewing that the commencement of the Carboniferous epoch found the metamorphism as complete as it is at the present day. The "cover" was therefore provided, not by the Carboniferous, but by some pre-existing strata, which must have been swept away, leaving apparently no trace behind.

It is perfectly clear that such a denudation as this indicates that for a very long period intervening between the Upper Silurian and Carboniferous Epochs the rocks were elevated above the sea-level and subjected to atmospheric waste. But in past times, as at the present day, if there was dry land in one place there was sea in another ; and, as wherever there is sea there must be some sort of deposition going on, so we should expect to find the gap filled up, and see what sort of beds they were that were first deposited and subsequently denuded away, if we went to the right place to look for them. Accordingly on travelling southwards to Ludlow and Herefordshire and parts of South Wales, we find an apparent sequence of rocks of enormous thickness intervening between the Carboniferous system and the equivalents of our Upper Silurian rocks, nearly, if not quite, filling up the gap we observe in our own district. The strata consist of the newest Silurian beds, including three subdivisions known as the Ludlow Beds, which graduate upwards into the "Passage Beds" or Tilestones. These again are said to pass up into the Old Red Sandstone of Herefordshire, a portion of which may probably belong to the Carboniferous system, and represent our Basement Beds. The whole mass of strata here seen, which are unrepresented in North Wales, is said to attain a thickness of about 10,000 feet.

In accounting for the absence of all these beds in North Wales, we might suppose, in the first place, that they had never been deposited there at all, that part having become land, while the Silurian sea still overspread the region to the south; or, in the second place, that they were deposited over both areas alike, but by unequal elevation had been subjected to greater waste in the one area than in the other. On the first of these suppositions we are met with the following difficulties:—There is no evidence in the Ludlow Beds of their having been deposited against a shore-line such as must have bounded the North Wales area on this hypothesis; and, further, how came the Silurian rocks of North Wales to be cleaved and metamorphosed if they were never covered with the later deposits of the period? On the other hand, it is in favour of the second hypothesis that near the Lake District, where the Upper Silurian re-emerge from beneath the Carboniferous rocks, they present a considerable similarity, both in sequence and fossils of the beds, to those of Central Wales, as though they had formed part of one continuous deposit. The difficulty in accepting this theory lies in the vast amount of denudation which it implies at a very early period, namely, before the commencement of the Carboniferous Period. And though we might be prepared, in observing such an unconformity as that shewn in the banks of the Clywedog, to grant that the Silurian strata must have been deeply denuded, yet it would have been a large assumption that so great a mass had been clean swept away, had no further evidence been forthcoming.

Before detailing this evidence it is necessary to give a short sketch of the beds as they occur in Central Wales and in Westmorland. In the former the Wenlock Shale, the highest member of the Upper Silurian that is present in North Wales, passes up into grey micaceous sandstones and shales with a band of very fossiliferous limestone, which are collectively known as the Ludlow series. This series graduates upwards into a thick mass of red beds, which, by their fossils, are allied to the Ludlow, but in colour resemble the Old Red Sandstone, and are therefore known as the Passage Beds, including the Tilestones. These are overlain by the vast thickness of red sandstone of which the Brecon Vans are composed. In Westmorland the Ludlow rocks and the Tilestones are clearly recognisable, as before stated. Inasmuch as these rocks do not occur *in situ* in North Wales, we must look for evidence of their former existence in some other form.

About three or four years ago MR. WALKER called my attention to some remarkable pebbles which were to be found on the beach near Llandulas, and stated that he had seen some of the same kind in a lane about a couple of miles inland. Eventually Ffernant dingle was pointed out to us, where the pebbles were seen to occur in a conglomerate, obviously forming part of the Carboniferous Basement Beds. The pebbles were of large size, and in great abundance. Their flattish shape indicated that they had been derived from a rock that split readily into slabs, and their rounded corners indicated that they had been well water-worn, and had probably travelled some little distance. On breaking them we observed that they were of a purple softish sandstone, highly micaceous and fissile, and frequently fossiliferous. The character of both the stone and the fossils was unmistakable. The pebbles were in fact the remains of the missing Tilestones. I do not know that we should have ever followed up this interesting search, if it had not been for the assistance most unselfishly given us by one to whom, I believe, most of us are more or less indebted—I mean MR. PRICE. He many years ago observed these pebbles and pointed out the dingle in which they occurred to MR. BOWMAN, who described the section before the Geological Society of London under the title of "A small patch of Silurian, West of Abergele."* Though we could not agree with all MR. BOWMAN's conclusions, especially in his naming the conglomerate as Silurian, yet it was a pleasure to confirm the accuracy of his work as we traversed the ground, and it is a pleasure now to testify to the merits of work done nearly 45 years ago, when geology was in its infancy. My only regret is that MR. PRICE did not himself bring forward his own observations, the result of years of patient and shrewd observation.

Time would not permit me now to enter into all the inferences we drew from this section. It is sufficient to say that the occurrence of pebbles of purple sandstone in such abundance led us to believe that the Ludlow or Tilestones must exist in places under the Carboniferous at no great distance; while from the absence of fragments of Wenlock Shale or Lower Silurian Beds we argued that the drift of the pebbles could not have been from the North-west, West, South, or South-east, for in

* Geological Transactions, Vol. vi., Part I. See also "On the occurrence of Pebbles with the Upper Ludlow Fossils in the Lower Carboniferous Conglomerates of North Wales," by A. Strahan and A. O. Walker. Quart. Journ. Geol. Soc., May, 1879.

all these directions these rocks form the floor on which the Carboniferous strata expose, and would have contributed their share of the débris; that the pebbles must therefore have been brought from the North or North-east, from an area intermediate between North Wales and Cumberland, and occupied not only by the newer strata, but now lying beneath the sea. But however this may be, I consider that the occurrence of this mass of pebbles, taken in connection with the metamorphism and cleavage exhibited by the Wenlock Shale and the extreme unconformity of the Carboniferous rocks upon it, are incontestable proofs that the Ludlow Beds and Tilestones once overspread the whole district from Central Wales across to the Lake District, but were denuded away from North Wales before the Carboniferous period, old as it is, had commenced. There can be no doubt that an unconformity such as this indicates the lapse of a great period of time. North Wales appears to have then formed portion of a continental area stretching far away to the North, mountainous and dotted with great lakes, for Professor Geikie has shewn that the Grampians must have then existed as a mountainous range, providing material for the formation of conglomerates of extraordinary coarseness in the long arms of land-locked basins. During this continental period, the Lower Silurian rocks, with their interbedded ashes and lavas, came to be exposed at the surface, for we find that near Llandudno the Carboniferous Limestone rests directly upon them. But though no doubt these rocks, then as now, exhibited under the process of waste their characteristic scenery, it is more than doubtful whether any of the existing valleys can be traced back to that early period. The Carboniferous Basement Beds of North Wales, unlike the Old Red Sandstone in Scotland, shew no tendency to run up any of the present valleys, but seem rather to have been spread on a gently undulating plain, as a fringe round the high ground of Carnarvon.

There now succeeded the great oceanic period in which the Carboniferous Limestone was deposited, followed by the estuarine and lagoon formations of the Millstone Grit and Coal-Measures; a mass of strata exceeding 18,000 feet in North Lancashire, and probably not less than 6,000 feet in North Wales, and extending in an unbroken sheet over the whole district, with the exception, possibly, of the Carnarvon mountains. At the close of this long period of subsidence, elevation once more took place, denudation ensued, and some of the present features of the country began to come into existence. The Carboniferous rocks were thrown into folds, and by the waste that took place along the lines of elevation, the Coal-Measures were separated up into distinct fields or basins. Along the line of the great Bala fault or axis of upheaval not less than 4,000 feet of strata were removed before the deposition of the New Red Sandstone, as is proved in the remarkable section near Hope Station, where this formation is seen resting on Millstone Grit. In the folds of depression, on the other hand, the strata were preserved from denudation, and it was in this way that the tongue of Carboniferous Limestone and Millstone Grit, which occupy the Vale of Clwyd, was preserved; for thrown down here by a synclinal fold and by great faults, these strata occupied a position far below the general level of the Carboniferous rocks, which were being wasted away on the uplands of Denbighshire and Flintshire. The Vale of Clwyd then first began to come into existence at the close of the Carboniferous period; occupied subsequently by an arm of that inland sea, in which the sandstone and salt-bearing marls of Cheshire were deposited, it must from that time to this have remained distinguished by its structure and scenery from the rest of North Wales. As a direct result of these post-carboniferous movements, was commenced that network of valleys, cut so deeply down into the old table-land of Silurian rocks, and occupied by the Elwy, the Clywedog, the Clwyd, and the Dee, and at the same time the principal features of the Snowdon range may have begun to be blocked out.

It may at first sight appear unreasonable to assume so great a denudation of the Carboniferous rocks to have taken place. That it is not so, a few observations on the effects of denudation, on rocks of equal hardness, but of much later date, will amply prove. During the Miocene period there was great volcanic activity in many parts of Europe, but more particularly in the region intervening between the North of Ireland and the West of Scotland. Great sheets of lava were poured out, extending from Antrim, where they are 600 to 900 feet thick, through the islands of Mull, Rum, Eigg, Skye, through the Faroe Islands, and Iceland. Speaking on this subject, RAMSAY says, "The "whole region has, by denudation, been changed into a line of "fragmentary islands, the high sea-cliffs of which attest the "greatness of the waste they have in time undergone." Again, in Iceland, JAMES GEIKIE has observed that there rise from a broad undulating plain lofty plateaus of lava, deeply gashed with gorges and abruptly terminated, so as to present cliffs to the low ground at the base; these are obviously mere fragments of a once continuous sheet of lavas about 3,000 feet thick. Through the valleys cut in these Miocene lavas the modern volcanic rocks have poured themselves, so as to produce a striking instance of unconformity between igneous rocks. Moreover, since this comparatively recent Miocene period, some of the greatest mountain ranges in the world have for the most part been elevated, as the Alps, the Himalayas, and the Rocky Mountains, so that beds of mud and clay that look like recent depositions in other parts, are found in the flanks of the mountains shewing the contortions and dislocations commonly seen in the older rocks. In the face of such evidences as these of upheaval and denudation at so late a period, I think we are not likely to err on the side of over-estimating the changes that have taken place since the very beginning of the secondary epoch.

What was the condition of North Wales through all the periods of the Lias, the Oolites, the Chalk, and the Tertiary beds, there is very little evidence to shew. But inasmuch as the Chalk may be seen in other parts to overlap all the lower Secondary formations towards the West, it may be assumed that the submergence during the Chalk was more general than in the preceding periods; it is not improbable even that this formation may have covered a portion, if not the whole, of North Wales, and have joined up those isolated fragments which still exist in the North of Ireland under a protective covering of Miocene basalt. It must be remembered that if neither the Chalk nor any of the earlier Secondary formations overspread North Wales, this district mnst have been undergoing denudation almost uninterruptedly from the close of the Carboniferous period up to the present day—a length of time so vast that, bearing in mind what has been effected on the far later Miocene rocks, it would seem as though the Welsh mountains, hard as they are, must have been levelled with the sea. That no trace of any of the Jurassic or Cretaceous rocks now occurs in North Wales would be readily explained by their comparative softness, and the readiness with which their *dèbris* would be swept away in such a general shifting of surface accumulations as took place in the Glacial Period.

During a portion of the Glacial Period the work of denudation was partially interrupted, and the valleys which had already assumed their present size and shape were more or less choked with very irregular deposits of boulder clay and gravel. From that time to this the work of the streams has been to clear out these obstructions from the old rock-valleys—a work that is not yet nearly accomplished. A remarkable instance of post-glacial denudation exists in the Vale of Gresford. The River Alyn, leaving the hilly region of Hope, winds across an undulating plateau of sand and gravel, which extends as far as the low-lying boulder clay plain of Rossett. In this plateau the Alyn has excavated a narrow but deep valley, reaching and cutting into the rock beneath; the material has been spread out by the river over many acres of the nearly level ground about Rossett, where the current lost its transporting power. And in many other cases the rivers flow in channels contained almost wholly in the glacial drift, which thus forms a protective covering to the rock beneath. When this has been removed, and the streams have once more regained their pre-glacial channels in the solid rock, the deepening of the valleys, so long interrupted, will be continued, until the next great terrestrial movement places North Wales once more beneath the level of the sea.

(ABSTRACT.)

A Problem for Cheshire Geologists.

BY PROF. JOHN W. JUDD, F.R.S., SEC. G.S.

Read November 27th, 1878.

AFTER some introductory remarks on the advantageous position of the City of Chester as a centre for geological research, attention was called to the proofs which exist of enormous masses of strata having been removed by denudation from a large part of the surface of the British Islands.

The Carboniferous rocks are now confined to a number of separate basins or coal-fields, yet careful research has demonstrated that these now isolated coal-fields were once continuous, and that they have been separated from one another by upheaval and denudation. Even in the Highlands of Scotland an outlier of the Carboniferous formation has been detected; this little patch having escaped removal by denudation through being covered by two thousand feet of basaltic lavas in Oligocene times, and by being subsequently thrown down by faults among the hard crystalline rocks of the Scottish Highlands.

It thus appears that the distribution of Carboniferous strata in the British Islands, at the present time, is very different to what it originally was, and the same is true of all the younger formations.

Both on the East and West coasts of Scotland patches of Poikilitic or New-Red-Sandstone strata have been found preserved through the action of faults, or by being buried under great floods of lava.

Of the Rhaetic, a very interesting fragment, forming a gigantic boulder, occurs at Linksfield, near Elgin. This fragment, now quite isolated, appears to indicate the former existence of strata of this age in the neighbourhood, and that portion of such beds has escaped denudation down to a very recent geological period. It may be interesting to call to mind that very similar Rhaetic strata, containing beds of coal, occur in Scania, the southern province of Sweden.

It is with respect to the Jurassic strata, however, that we possess the most striking evidence concerning their former wide distribution, and the extensive removal of their beds by denudation. And it is in regard to the beds of this age that it is especially desirable that the attention of geologists residing in Cheshire and the adjoining counties should be aroused.

The greater part of the Lias, and much of the Oolitic strata appears to have been deposited in moderately deep water. Hence it is quite impossible to suppose that the patches of Lias and other clays to which we are about to refer could have been deposited in their present isolated condition.

If we follow the outcrop of the Jurassic strata from the South-west to the North-east of England, we shall find beyond its limits many scattered patches of strata or outliers, which were evidently once connected with the strata forming escarpments in their immediate vicinity, but are now isolated by denudation. Beyond these outliers, which were manifestly once a part of the main mass of the strata in their neighbourhood, we find a number of others, some of them situated at very great distances from the main line of outcrop.

That Jurassic strata were originally deposited over the Mendip area was shown by the late Mr. Chas. Moore, who found Rhaetic and Liassic fossils occupying deep fissures in the Carboniferous Limestone of the district.

In Somersetshire and South Wales, there are patches of Liassic strata lying far to the West of the general line of outcrop of those beds; and similar outlying fragments are found about Copt Heath in Warwickshire, and Needwood Forest in Staffordshire. Similar outliers, but still farther removed from the parent mass, are found in North Shropshire and Cheshire and in the neighbourhoood of Carlisle. Still farther away, about Portrush and Rathlin Island in the North of Ireland, in Morvern, Mull, Ardnamurchan, Raasay, Skye and the Shiant Isles in the Western Highlands of Scotland, and again in Ross, Sutherland, and Caithness, in the extreme North-east of Scotland, similar patches of Jurassic strata are found.

If we turn our attention to the Cretaceous strata similar facts force themselves upon our attention. Strata of the age of the Upper Greensand and Chalk, which are found overlapping all the older rocks in Dorset and Devon, reappear in Antrim and the adjoining counties of the North of Ireland, and again in Mull and Morvern. In the intermediate area, and even as far Northwards as Aberdeen, the occurrence in the drift of Chalk Flints often containing fossils points to the former wide extension of the Chalk strata. Now the globigerina-ooze of the Chalk was certainly not a shallow-water deposit, and if Chalk be proved to have been deposited at all these different points in the British Islands, it must have also covered, at one time, the intermediate ones. Hence we are driven to the conclusion that what is true of the Lias and other deep-water Clays of the Jurassic period is *a fortiori* true of the Chalk. All these formations had originally a much wider extension over the British Islands than they exhibit at the present day.

Let us recall to our minds the singular accidents by which alone these patches of Secondary strata have been preserved for our study. In some cases, as in Morvern and Sutherland, the strata have been dislocated by faults with a throw of certainly not less than 2,000 feet and the softer Jurassic rocks are found wedged in between the harder crystalline masses. In other cases, as in Antrim and Skye, they have been buried under 2,000 feet of lavas poured from neighbouring volcanoes. In others again, as at Linksfield and Aberdeen, they have been transported on ice-rafts and buried in glacial deposits. Bearing all these facts in mind it seems quite impossible to resist the conclusion that the Secondary strata once spread over far wider areas than those in which they are now found, for wherever the necessary conditions for their preservation exist, there the patches of Secondary strata occur.

If we remember the depth of water in which the Jurassic clays and the Chalk strata were probably deposited, and the thickness which they attain, it will be difficult to resist the conviction that almost the whole of the British Islands were at one time covered by deposits of Secondary age.

It may seem a startling conclusion that at the commencement of the Tertiary epoch a large portion of the British Islands was buried under thick strata of Liassic and Oolitic age, and still more surprising that at the same period a great winding-sheet of Chalk strata varying in thickness from a few hundreds to two thousand feet, enveloped the whole, or nearly the whole, of our country, but from this conclusion I can see no escape.

What then has become of these vast masses of rock? The answer is a simple one—they have been removed by denudation. That anything like this amount of denudation can have taken place since the commencement of the Tertiary period some may find it hard to believe. A very little consideration, however, will convince us that we, in this country, are apt to greatly underrate the importance and duration of the several periods of the Tertiary epoch.

It happens that in this country the Eocene and Oligocene strata are comparatively thin and modern-looking deposits, the Miocene is non-existent and the Pliocene insignificant. But in other areas we find startling proofs of the enormous intervals of time represented by these several systems of strata.

Every foot of sediment deposited implies the destruction of so much old rock. Now, as shown by Lyell, a very great portion of the continent of Europe has been submerged at one period or another since the commencement of the Tertiary, and on these submerged areas strata, often of enormous thickness, have been deposited; out of such strata masses like the Rigi and Mt. Pilatus have been carved by denudation. Each of the great Tertiary systems—the Eocene, the Oligocene, the Miocene, the Older Pliocene and the Newer Pliocene—is represented at one point or another by strata thousands of feet in thickness.

It is not necessary, however, to go beyond the limits of our own islands in order to find proofs of the great amount of denudation which went on during the Tertiary periods. Around London we find great masses of water-worn flint pebbles (the Oldhaven beds) 50 feet or more in thickness, which must represent the destruction of many hundreds of feet of Chalk. Still more impressive is the fact that the volcanoes of the Western Highlands of Scotland, which in the middle portion of the Tertiary period rivalled Etna in height and bulk, are now reduced to "basal wrecks," none of which exceed 3,000 feet in height. All the existing grand mountain-ranges of the globe appear to have originated in the Tertiary period, for so great is the work of denudation that the older mountain-chains have been worn down into insignificant ridges.

From what has been said, everyone must admit that the greatest interest surrounds these isolated patches of Secondary strata. By their critical study the geologist is led to entertain juster views concerning the past history of the district in which they occur, and to acquire more correct notions of the sequence of the events which have taken place in successive geological periods.

Now there is situated at no great distance from the City of Chester one of these patches of Secondary strata, many of the details concerning which require to be carefully worked out, in a manner which is only possible for residents in the neighbourhood.

The patch of strata in question is by no means inconsiderable in size, for it has a length of from 10 to 12 miles, and a breadth of about 4 miles. It is oval in form, lying with its longer axis from N.E. to S.W., between Audlem and Wem.

The existence of this interesting outlier appears to have been first made known to geologists by the late Sir Roderick Murchison, in a short paper in the Proceedings of the Geological Society for 1835.

The Geological-Survey map of this district was published in 1855; the attempt to lay down the boundaries of the outlier is confessedly an imperfect one, for a geological surveyor visiting the district for a short period is at a great disadvantage compared with the local residents who can utilize every accidental opening made during a long course of years.

In 1863 Mr. Morton read a paper before the Liverpool Geological Society, describing the outlier. The paper appears to be based on observations made during a short visit to the district.

In 1865 the Rev. P. B. Brodie read a paper before the Warwickshire Field Club, and gave a careful summary of all the facts bearing on the question which had up to that time been ascertained.

Since that date I am not aware that any fresh observations on the subject of this interesting outlier have been published.

Now the points concerning which our information appears to be up to the present time very imperfect are the following :—

I.—*The exact* EXTENT *and* LIMITS *of the outlier*. Thick masses of drift conceal the greater part of its surface, and hence a great portion of its boundaries have been indicated by dotted lines on the map of the Geological Survey. By taking advantage of any wells sunk in the district, and by recovering any records or specimens of the old sinkings in search of coal, something might no doubt be done to remove existing doubts.

II.—*The* RELATIONS *of the Lias to the surrounding strata*. That the mass has been let down by a fault there cannot be the smallest doubt. This fault has been traced through a part of its course by the geological surveyors; but further research may be expected to throw light on the continuation of this great fault and on the position of parallel and branch faults which are probably connected with it. A careful discussion of the thicknesses of all the deposits in the district would perhaps permit of an estimate being made of the amount or "throw" of the fault.

III.—*The* NATURE, THICKNESS, *and* FOSSIL CONTENTS *of the strata which make up the outlier*. The limits and thicknesses of the Upper, Middle, and Lower Lias, the existence of Rhaetic strata, and the succession of the several fossiliferous zones which make up these formations, all require to be determined. Careful workers, like Mr. Wright of Belfast and the late Mr. C. Moore of Bath, have shown that a whole museum of organisms may be procured from a few lumps of clay; and similar methods of research may be expected to yield not less interesting results in the case of this outlier.

In conclusion, it was suggested that a Committee might be appointed by the Chester Natural Science Society to investigate the whole subject; and it was pointed out that this course had been taken by the Geological Society of Edinburgh, in the case of the fossiliferous deposits of Silurian age near that city, with the most satisfactory and encouraging results.

Traces of an Interglacial Land-surface at Crewe.

BY D. MACKINTOSH, F.G.S.

Read March 4th, 1880.

DURING a number of visits to Crewe Railway Station in 1879-80, I had opportunities of examining sections and specimens of an exceedingly fine and (when damp) more or less flexible kind of book or leaf-clay. They were exposed in excavations for underground passages and drains. I did not see the bottom of the leaf-clay, but Mr. ANDREWS (Assistant Engineer) informed me that he had seen it resting on quicksand. The clay, within a vertical extent of about a foot, graduated into very typical and undisturbed upper Boulder-clay, about ten feet in thickness.

This leaf-clay is evidently on the same horizon as numerous similar deposits which may be seen in many parts of Cheshire and Lancashire, at or towards the base of the upper Boulder-clay, and which range as low down as the present sea-level. In many places these deposits show ripple-marks of a kind which are usually formed in very shallow water, though I did not see any ripple-marks on the clay at Crewe Railway Station.

The leaf-clay under notice is the finest of any yet examined by the well-known foraminiferist, Mr. SIDDALL, of Chester, who found in it a shallow or brackish-water species of Foraminifera, namely, *Polystomella striatopunctata*. The laminæ of which the clay is composed are generally very thin, but they can easily be separated, owing to an intervening sprinkling of sand, which, at intervals, may have been distributed by shallow currents of water, or blown by wind *(see sequel.)*

One of the most striking features of the leaf-clay is the extent to which the surfaces of the laminæ are pitted. I have little doubt that some of the pits (especially those steeper on one side than on the other) were produced by rain when the surfaces of the laminæ were above water; but in most instances they can be better explained by supposing the escape of imprisoned bubbles of air; and Mr. SIDDALL believes that he has seen a confirmation of this theory of their origin in experimenting with the clay while dissolved in water contained in glass bottles.

Clay, very similar to that found under Crewe Railway Station, may now be seen in course of accumulation along the shores of some parts of the estuary of the Mersey, and more especially in the back-waters of the Menai Strait; and Mr. SIDDALL is of opinion that the Crewe leaf-clay was deposited within the tidal range; but while believing that it may have been partly formed between high and low water, I have seen very similar clayey laminæ with intercalated sprinklings of sand, and pits left by air-bubbles (besides rain-pits) at some distance from the sea. Around Birkenhead (and I have no doubt elsewhere), at the bottom of excavations made for obtaining clay for making bricks, rainwater, assisted by wind, has produced a laminated clay very similar, in the respects already named, to that found under Crewe Railway Station, with the addition of marks (in the Birkenhead excavations certainly, and at Crewe probably), left by the crawling of worms.

During his microscopic examinations of the Crewe leaf-clay, Mr. SIDDALL found the débris of plants, including rootlets, one of which certainly was in the position in which it grew, as it extended through the clayey laminæ in a direction of nearly right angles to the planes of lamination; in other words, it occupied a position in which a drifted specimen could not well have remained had the laminæ been accumulated around it by currents of water.

From all the above facts and considerations, I think it may be regarded as highly probable, if not certain, that in Cheshire, the land before the commencement of the submergence which accompanied the deposition of the upper Boulder-clay, with its intensely striated stones, stood at a level not much lower than it does at the present day.

The Silting up of the Dee: its Cause.

BY W. SHONE, F.G.S.

Read December 18th, 1884.

IN the year 1875 I commenced a series of observations on the tidal phenomena of the River Dee. By the courtesy of Captain HILLS, R.N., the Marine Surveyor of the Liverpool Dock Board, I was allowed to have access to their splendid tide gauge on Hilbre Island, by aid of which the facts forming the foundations of this paper were obtained. I wanted several links, however, in the chain of observations between Chester and Hilbre, and they have recently been supplied by the evidence of Captain ALLDRIDGE, R.N., before the Committees of the Houses of Lords and Commons in March this year, on the subject of the erection of the railway bridge over the Dee at Connah's Quay. Captain ALLDRIDGE surveyed the river for the Admiralty as far back as 1851, and again in 1867. His knowledge of the Dee is consequently very extensive.

THE ANCIENT SILTING UP OF THE DEE.

The silting up of the Dee dates very far back, and it would be as well to briefly refer to such evidence as we possess upon this part of the subject.

If we examine the most ancient maps of Chester, we find that the river flowed fairly straight from the Old Dee Bridge to the site of the Grosvenor Bridge, and that it was there deflected by an outcrop of rock in the bed of the stream against the clay cliffs of Curzon Park. These in turn deflected the river round the Roodee, making a very sharp curve, which caused the stream to pass by the Watergate along the City Walls, past the Water Tower (which stood out in the river), then it ran along by the site of Whipcord Lane, keeping by the clay cliffs of Blacon, and thence towards Parkgate to the sea.

When the sewerage works at the Sluice House were in progress, I found a number of the whole shells of the common cockle, mussel, Tellina, Mactra, and also fragments of the same; in fact, the excavated sand contained in bulk quite a fourth part of such fragments, mingled with microscopic but perfect shells of Foraminifera, &c. The River Dee Company, some years ago caused bore holes to be made through the reclaimed land near the Higher Ferry, when it was found that the "sea-sand" was 24 yards deep. The time required to deposit this great thickness of sand in the bed of the Dee would carry us far back beyond the period of the Romans, to the commencement of the silting up of its estuary. Before, therefore, the date of this, and indeed long after it was in progress, our city was situated on an arm of the sea, in which the salt water was ever present, and the river entered this creek through the rocky channel between the Castle and Handbridge. This creek from Hilbre to Chester was not so wide in Roman times as it is now, because we find the remains of peat with tree stumps standing up *in situ* on the shore near Dawpool; and again on the Little Eye near Hilbre peat occurs, and in this latter place it (the peat) yields Roman and Saxon relics, proving it to have been a land surface within the historic period. A tract of land, some mile in width and six miles in length, has, within comparatively recent times, been swept away between Hilbre Island and Heswall, near Parkgate; and how much more, there is no evidence to show, beyond the fact that the high cliffs of boulder-clay along the Dawpool shore are being rapidly worn away by the rain, the frost, and the tide.

The Geological History of the Dee.

On the termination of the Glacial Period, the present land rose out of the sea, when the beds of boulder-clay and sand (the remnants of which form the banks on either side) stretched across the present estuary of the Dee from the Cheshire to the Flintshire shore. The River Dee then probably cut its channel midway between Cheshire and Flintshire. At the beginning of its geological history the Dee would quickly cut its course, but as it cut its channel deeper and deeper from Bala to the sea, the fresh-water stream would become less powerful, the tidal waters of the sea would overcome the action of the river, and commence the widening of the mouth from the sea inland. Hence the fact that the estuary is six miles wide at Hoylake, tapering to a point at Chester—some twenty miles distant as the crow flies. That was the period of the scooping out of Sealand, then followed the filling in—the tidal waters of the sea began to be glutted with sediment which it could not take away, and the fresh waters of the river were powerless to remove it; hence the formation of the great East and West Hoyle Banks at the entrance of this creek or arm of the sea, which play a very important part on the tidal action of the estuary.

The Recent Silting up.

I shall now, however, dismiss the remote past, and come to the crucial point—the recent silting up of our river and its cause. A writer in the 14th century describes the Port of Chester in the following terms:—"There, where the sea hath determined that creek which shoots in between Flintshire and the west side of Wirral Hundred, was founded that beautiful City of Chester and made the receptacle of merchandise from all kingdoms and nations who traded into the British or Irish Ocean, and became the very key or inlet, whereby not only the Romans in their time made their passage to and from Ireland and the other western and northern island, but all kings and princes ever since." In the 17th century the navigation became very bad, and it was stated by a writer "that the haven which in times past received ships of great burden up to the city skirts, scarce now hath sea room for little barques, which only at high water do bring in their unladings of great vessels from the quays and stations which receive them five, six, or ten miles off. And hence it is that within these few years there have been such losses and gainings between the shores of Cheshire and Flintshire near unto this city that, if I could estimate the same according to my own judgments, I should scarcely be believed of such as do not behold them with their eyes." In 1730 a company of proprietors was formed, and, headed by Nathaniel Kinderley, they obtained an Act of Parliament to reclaim the "white sands," as Sealand was then termed. They diverted the river from the Cheshire to the Flintshire shore by digging a "cut" eight feet deep, and throwing up this sand in the form of an embankment, which we call the "Navigation Cop." With the question how far the River Dee Company has performed its trust to the citizens of Chester—in return for the fertile and valuable lands reclaimed—it is not within the scope of this paper to discuss; but the manner in which the river was so diverted and constructed by their Engineers is—because, I hope to point out to you that they could have made it so as to promote its power of scouring out its course, instead of, as I affirm, giving the flood tide every facility for bringing sediment up the river, and checking in every way the return of the ebb.

The Silting up: How Caused.

To begin, therefore. The width of the river at high water of ordinary spring tides is, between Chester and Saltney, 285 feet; at the Higher Ferry, 400 feet; at the Lower or King's Ferry. 500 feet; and at Connah's Quay, 850 feet. What is the consequence of this? The bore or head of the tide: About a mile from Connah's Quay the river narrows to 500 feet, and as soon as it narrows the rapidly flowing tide becomes confined—shoots, rather than flows, forward at the average rate of from seven to eight miles an hour, and sometimes as much as ten miles an hour. On December 4th, 1884, I watched the tide coming in at the Saltney turn of the Cop (Chester side). At 10-40 a.m. the bore passed; it was a magnificent sight. First long tongues of water darted along the sides of the river; then a roaring wave, continually breaking as it swept along, followed by others, unbroken, in quick succession, for a space of 200 yards. This mass, some three feet deep, moved forward at the rate of 8 1-5th miles an hour. Grand as the spectacle was—witnessed as a natural phenomenon, exhibiting the powers and forces of nature as it passed—tearing up the sandy bed of the river, and hurling it forward in its course—on the other hand it was, however, lamentable to reflect on the consequences to Chester and her trade that it caused, and one actually created by the stupidity of man—inviting the advancing tide to enter the river at Connah's Quay by a wide mouth, and then decreasing the channel from 850 to 285 feet in the course of seven miles. I have here samples of the water taken just before the bore passed, and five minutes after. The former is, you will observe, muddy, because the river had a very heavy fresh in it, but the latter is so densely charged, and that too with *heavy* sand, that it is no sooner shaken than the bulk of the sediment immediately falls to the bottom of the bottle. The same things take place in the river as in these two bottles. The bore charged with heavy sand moves forward, pushing it tide by tide higher and higher up the Dee until stopped. And where is it stopped? At unfortunate Chester. There the stupidity of man has further placed a causeway, against which the bore rushes to fall back again like a giant felled; and as if this were not sufficient, the Canal Company tap the fresh-water river at Llangollen, taking from it a broad stream of ever-flowing water, which finds its way (by way of Chester) into the Mersey, except there should be more than is required, then a little trickles over the lock-gates at the Lower Basin again into the river. I think the most brilliant imagination could not, however, conceive this to be the fine stream which flows out of the Dee at Llangollen, in process of being returned—with thanks—to the Dee at Chester. If the waters of the Upper Dee were not robbed for the Canal, and if the bore, instead of being stopped and stunned by the causeway, were allowed to flow as far as it could up the river, there would, in the going out of the tide, be some compensation for the damage it does in coming in. I think there is some scheme on foot for putting sluice gates on the causeway to help the scour; but if anyone would consider the width of the river to be cleared, and the puny force of the largest possible sluice gates to the force of the vast volume of water brought in each day by the tide in two and a half hours, he will liken the attempt to that of the good lady who strove to stop the Atlantic in a storm from invading her doorstep by pushing it back with her broom. To my mind it might spoil the Upper Dee, while it would be of no practical good to the Lower Dee. In the case of the causeway, it is all or none. The next question is

How does the Tide come in?

On December 4th, already referred to, the bore or head brought in three feet of water in less than five minutes, and in ten minutes there were four feet, which increased to nine feet in 37 minutes. The tide still continued to slowly flow for one hour and eleven minutes longer, only making, however, seven inches increase in depth. The total flow was an hour and 48 minutes, and the total depth of water brought in was 9 feet 7 inches. It follows, therefore, that the total rise for the first ten minutes was four feet, in 27 minutes more to nine feet, and in the next hour and eleven minutes only seven inches. There was a big fresh in the river for the tide to overcome, and a gale from the north-west assisting it to flow.

How did it go out?

I took the depth three hours and fifty minutes after the tide turned, and it had only run out or fallen four feet ten inches. So that out of the nine feet of tidal flow which came up the river in 37 minutes, only four feet ten inches had returned in three hours and fifty minutes after high water. You will notice also that four feet of water came in within ten minutes, while only four feet ten inches went out in three hours fifty minutes.

The Power of Running Water.

Sir Charles Lyell, in his "Principles of Geology," states that the power of running water has been proved by experiment to be as follows:—A velocity of three inches per second at the bottom is stated to be sufficient to tear up fine clay, six inches per second fine sand, twelve inches per second fine gravel, and three feet per second stones the size of an egg. The bore travelled on December 4th 88 yards in 22 seconds, or at the rate of twelve feet per second, or four times as fast as a stream capable of tearing up stones the size of an egg. What a terrible effect this bore must have as it passes up the sandy bed of the Dee.

The Estuary.

I have so far treated only of the Dee between Chester and Connah's Quay, where it is artificially confined between embankments. I must, therefore, now briefly notice the phenomena of the tidal flow and ebb of the estuary. In May, 1875, I made a number of observations on the tidal action between Hilbre and Chester. I will select two examples. The first, the morning tide of May 20th, 1875. At 5-30 a.m. the tide guage registered at Hilbre 6ft. below old dock sill. It rose as follows:—The first hour after low water 2ft. 4in. per hour; in the second hour, 4ft. 8in.; third hour, 6ft. 3in.; fourth hour, 5ft. 9in.; fifth hour, 2ft. 9in.; in the last three-quarters of an hour, 3in.; total rise, 22ft. Thus in the first two hours' flow the tide rose 7 feet, in the next two hours to 19 feet, and in the last hour and three-quarters to 22 feet, the total rise. This tide flowed at Hilbre for 5 hours and 45 minutes. In the third and fourth hours it flowed more than half the total rise. Now, what took place at Chester? The head or bore passed the Cheese-stage at 10.23 a.m., when it was then nearly high water at Hilbre; the tide at Chester flowed for an hour and forty-six minutes, and there was a total rise of the tide of 11ft. 6in. at Chester, giving the speed of about five miles per hour between Hilbre and Chester as the average rate of progress of the flood.

THE TIDE AT HILBRE.

Does the tide come in or go out at Hilbre more quickly? It comes in more quickly than it goes out. I have the full particulars of the morning tide at Hilbre on April 7, 1875. The rise was as follows:—First hour, rise per hour 2ft. 8in.; second hour, 6ft.; third hour, 8ft. 11in.; fourth hour, 7ft. 10in.; fifth hour, 4ft. 1in.; and last 20 minutes, 6½in.; 5 hours 20 min., total rise 30ft. 0½in. How did it go out? First hour, fall per hour, 2ft. 4½in.; second hour, 5ft. 3in.; third hour, 6ft. 9in.; fourth hour, 6ft. 9in.; fifth hour, 5ft.; sixth hour, 3ft. 9in.; last 40 minutes, low water, 1ft. 4in.; 6 hours 40 minutes, total fall 31ft. 2½in. The tide at Hilbre, you will notice, comes in with its greatest strength during the third and fourth hours, and likewise goes out most quickly during the third and fourth hours of the ebb. For instance, the tide flowed 16ft. 10in. in the third and fourth hours of the flood, and went out 13ft. 6in. during the third and fourth hours of its ebb; there is a deficiency on the flowing out of the ebb of 3ft. 4in. in depth, as compared to the rate of rise of the greatest flow. While it took the whole tide only 5 hours 20 minutes to come in, on the other hand it took to go out 6 hours 40 minutes, or 1 hour 20 minutes longer on the ebb than the flood. What does all this mean? It means the silting up of our estuary slowly but surely. And here again the stupidity of man has conspired to hasten it by reclaiming the "white sands," or Sealand, and hence embankment after embankment, and so reducing the power of the scour of the returning tide in the estuary. The sediment which will come in on the flood, and part of which will remain on the ebb in our estuary for ever, is thrust forward; and as every new embankment is advancad towards the mouth, this deposit is also thrust forward. We need no better example of this than the rapid silting up along the shore from Burton Point to Parkgate within the last hundred years.

THE CAUSE OF THE BORE.

The slope of the tidal flow between Hilbre and Chester.—I have already stated that it is nearly high water at Hilbre when the bore or head of the tide passes the Cheese-stage at Chester. Now, the channel between Hilbre and Chester is about 25 miles in length, and if we suppose a tide to rise 25 feet at Hilbre, it follows that when the head comes up to Chester the slope would be 25 feet in the 25 miles, or one foot per mile. This body of water, travelling at an average rate of five miles an hour, is invited to enter our river at Connah's Quay by an opening 850 feet wide, which is shortly reduced to 500 feet, and thence to Chester, narrowed in seven miles to 280 feet. Can we wonder that the destructive bore is the consequence? It must be understood that all my observations refer to ordinary or high spring tides; of the neap tides the phenomena are the same but much less in degree.

THE EFFECTS OF THE FRESHES.

The fresh water floods or "freshes" clear the channel between Chester and Flint.—In an average year there are some half-dozen freshes, which clear out of the bed of the river much of the sediment brought up by the tides. Were it not for such floods the Dee, from Chester to Connah's Quay, would have been reduced to a brook long ago, but on the whole I am informed by the supervisor of the river that the upper part, say from the Higher Ferry to the causeway, is being silted up despite the partial effects of occasional floods cutting out a channel. This is the strongest evidence that the silting up is from the seaward, because the river is very free from sediment above the causeway except during floods, and these appear to be so strong at times as to be able to carry their own sediment into the estuary, together with much of the sediment deposited by the tide between the occurrence of each fresh. The force of these freshes is exhausted in attempting to undo in as many days what the tides have been doing in as many weeks. Now suppose we got rid of the bad effects of the incoming tide, and strengthen the power of the freshes or floods coming down from Bala to the sea, by so reconstructing our river between Chester and Flint, as to make it as difficult for sediment to come up, and as easy as possible for the freshes to remove any that might so find its way in; or in other words, endeavour to utilize the force of the freshes to the uttermost, whilst reducing to a minimum the power of silting up the channel by the incoming spring tides, then we might, I think, undo much of the evil of the past, and many of us live to see Chester once more recognised as an important port of Her Majesty's United Kingdom, and again justify the words of the writer in the 14th century, who described our town as situated "where the sea hath determined that creek which shoots in between Flintshire and Wirral, and whereon was founded that beautiful city of Chester, which was made the receptacle of merchandise from all kingdoms and nations."

An ancient opinion in support.

As you may have noticed, I had finished my paper with, to my mind, an appropriate peroration, when, a few days ago, the City Surveyor placed in my hand a copy of the proceedings of the "Admiralty Inquiry into the Dee Navigation," which opened on September 5, 1849. I had been searching for this report, but up to then without success. In it I find a map of the Dee in 1732, by John Mackay, mathematician, and a note as follows:—"Between Chester, Flint, and Parkgate, 7 or 8,000 acres are proposed to be gained from the sea, by which means no less than two hundred millions of tons of Tyde will be prevented from flowing there (twice in 24 hours), which on the reflux, acquireth the greater velocity to scour and keep open the Lake (*i.e.*, Hoylake) and Barr (*i.e.*, Chester Bar). Whether these ill consequences (which most certainly attend the present undertaking, *i.e.*, Nathaniel Kinderley's Inclosure Scheme) are not more likely to destroy the present navigation in Hyle Lake and the River Dee, rather than recover and preserve a better, is humbly submitted to the Right Honourable the House of Lords." So much for the originality of my idea that the embankments advanced from time to time tend to choke up the estuary. Original on my part it certainly was, but John Mackay had, however, been before me by no fewer than 152 years. I find the materials accumulated on my hands so great that I cannot deal with them in one paper, so I hope to follow this with another on the silting up of the estuary, and the effects of Nathaniel Kinderley's Inclosure Scheme on the Dee Navigation.

Discussion.

Dr. Stolterfoth expressed the thankfulness of the Society to Mr. Shone for his very valuable contribution, the fruit of so much original labour, inquiry, and reflection upon the facts presented on the face of nature. He had dealt ably with a difficult question. He (Dr. Stolterfoth) thought they ought to be careful not to attach too much importance to the statements of old writers about large vessels coming up the Dee, for what would be considered large vessels in those days would only be considered small vessels in these days. He believed that in the 13th or 14th century the Dee was very much silted up, and that silting up had probably been added to in the intervening time. He would ask when the causeway was put up.

Mr. Shone said he had looked into Ormerod on that subject, and he stated that there was a tradition that it was built in the time of Edward the Confessor; but Ormerod only copied that from Webb, and he did not know where Webb got the information.

Dr. Stolterfoth said there had evidently been a rocky bed before the causeway was put in.

Mr. Shone said that was so, or else the causeway might have been undermined by the water.

The Chairman said he was a little disappointed that more interest was not taken in this subject by the citizens. He criticised Mr. Shone's contention as to the quantity of matter swept up by the bore, thinking that the dirt arose from the scouring of the mud on the banks of the stream by the rush of water, and that most of it would be returned with the receding tide. Otherwise, according to Mr. Shone's argument, he should have expected a large deposit of silt just below the causeway. He was sorry that his friend had not gone further back in the history of the Dee; it was once an inlet of the sea, reaching up to Chester, and half as wide again as in historic times. There had been, so to speak, two River Dee's—one historic, the other pre-historic. The former, an arm of the sea, had a depth in places of over 100 yards, but it did not pass the rocky barrier between Handbridge and the Castle; the upper water of the Dee at this time finding its way over Boughton Fords, through Trafford and the Marshes to the Mersey. They had proof of the older river in sundry sinkings which had been made within the last 20 years on Sealand, at Mr. Gorst's Farm 48 yards of clay, sand, and gravel was found; at the Cross Roads 64 yards, and at Mr. Potts's land, near Shotwick, it was 100 yards deep. In Roman times it was only half as wide as formerly. The rocky barrier at Chester was then broken through, thus allowing the upper waters to pass into the present channel. He attributed the filling up of the river in part to the erection of the causeway, as materially lessening the natural scour, and said that although the date of the erection was uncertain, he had reason to think it was not built by the Normans. The old bridge was post-Norman work. As to the Romans having built the causeway, that was out of the question, as it would have destroyed their fords. He further pointed out that the Ancient Records of Chester showed that 500 years ago, in the first year of Richard II., probably 150 years after the causeway was built, the citizens complained of great depression of trade, consequent upon the destruction of the port and the gradual silting up of the river. A similar complaint was made in 1508, in the reign of Henry VI., and the King remitted £50 out of the annual levy of £100 paid to His Majesty on consideration that he maintained the City Walls.

Mr. Shone replied, and, in answer to the Chairman, described the sweeping away of a quantity of gravel, which he deposited in the river, by the bore. If large pebbles could be carried 150 yards up the stream, surely it showed the power of the bore to bring with it sand from below. As to the remark about his argument leading one to expect a large deposit of silt just below the Causeway, he pointed out that the power of the "freshes" was the greatest in that comparitively narrow part of the river, and weakened as the river became wider lower down. Further than that, he learned that this year there had happened what was never known before, namely, that Kettle's Hole, just below the causeway, was filled up with sand, and remained so till a fresh came. There had also been such a deposit of silt near the Grosvenor Bridge that the water from the Dee Mills could not get away.

Climatic Causes affecting the distribution of Lepidoptera in Great Britain.

BY A. O. WALKER, F.L.S.

Read before Lancashire and Cheshire Entomological Society, July 30th, 1883.

FEW people can have undertaken the study of any class of Animals or Plants without being struck by the unaccountable way in which many species are confined to limited areas. And this is especially remarkable in the case of winged insects, such as the Lepidoptera, provided with powerful means of locomotion, and, in addition, liable to be carried considerable distances against their will by gales of wind. Yet it is notorious that many species are confined to extremely small areas, and even to one particular field in a large district.

Let me say at the outset that I am fully aware of the difficulties of the subject. The number of persons able and willing to make and record observations on the occurrence even of so popular a class of Insects as the Lepidoptera is very limited, especially in those districts where Butterflies and Moths are not very abundant, or where, as in North Wales, there are no large towns to act as centres of intellectual energy, and the number of species recorded will certainly be affected by the number of recorders. Again a very slight preponderance of larva breeders or "sugarers" in any district will lead to a greater number of *Bombycina* or *Noctuina* respectively being recorded there as compared with other orders. Yet in spite of these and other difficulties, I believe that a tolerably fair comparison may be made between districts which have been worked by good Entomologists. The district adopted by the Chester Society of Natural Science, consisting of Cheshire W. of a line drawn S. from Warrington, with the Counties of Flint and Denbigh, has been well worked in the Hundred of Wirral by the late MR. BROCKHOLES (who published a list of the Lepidoptera many years ago), MR. COOKE, and no doubt others; also on the E. side by the late MR. NOAH GREENING, who furnished me with a list of captures on our side of Warrington. The Welsh portion, and that near Chester to the S. and E., has been but imperfectly worked, but I have had a considerable amount of information as to the Lepidoptera from Mr. Brockholes, my friend Mr. F. Archer, and others, besides having worked there myself at different times. I think, therefore, I am justified in drawing conclusions from a comparison of our district with others.

Taking first the Butterflies as the most easily and frequently observed we find 65 species, or excluding *L. Artaxerxes* as a mere variety of *Agestis*, and *P. Hippothoë* as extinct, 63. Of these, 28 are said to be generally distributed (see list), 22 occur chiefly in the S. and E. parts of England, diminishing towards the N. W., 3 only occur in the Northern Counties of England or in Scotland, and 3 are considered as stragglers from the Continent.

SPECIES GENERALLY DISTRIBUTED.	SOUTHERN SPECIES.	NORTHERN SPECIES.
*P. Brassicæ**	*G. Rhamni**	*E. Blandina*
*Rapæ**	*C. Edusa**	*Cassiope*
*Napi**	*Hyale*	*C. Davus**
*A. Cardamines**	*A. Cratægi*	
*L. Ægeria**	*L. Sinapis*	**LOCAL SPECIES.**
*Megæra**	*A. Galathea*	*P. Machaon*
*H. Semele**	*H. Tithonus**	*M. Cinxia*
*Janira**	*L. Sibylla*	*T. Pruni*
*Hyperanthus**	*A. Iris*	*L. Arion*
*C. Pamphilus**	*V. Polychloros**	*Acis*
*C. Cardui**	*G. C.-album**	*S. Paniscus*
*V. Atalanta**	*A. Paphia**	*P. Actæon*
Io	*Adippe*	
*Urtucæ**	*M. Athalia*	**STRAGGLERS.**
*A. Aglaia**	*N. Lucina*	*P. Daplidice*
*Selene** } Not in Ireland	*T. Betulæ*	*A. Lathonia*
*Euphrosyne** } Not in Ireland	*W.-album*	*V. Antiopa**
*M. Artemis**	*L. Corydon*	
*T. Quercus**	*Adonis*	
*Rubi**	*Ægon**	
*C. Phlæas**	*P. linea**	
L. Argiolus	*Comma*	
*Alexis**		
*Alsus**		
*Agestis**		
*T. Tages**		
*P. Sylvanus**		
S. Alveolus (not recorded in Chester District.)		

* Have occurred in District of Chester Natural Science Society.

Note—The arrangement adopted is that of Stainton's Manual, from which also the food plants and localities are taken, except as regards the Chester District and Yorkshire. The species in the latter county are taken from Yorkshire Lepidoptera, Porritt, 1883.

In the first class (species generally distributed) *A. Euphrosyne* and *Selene* have not been found in Ireland. As regards our own district *H. Hyperanthus*, *A. Aglaia*, *A. Euphrosyne*, *L. Argiolus*, and *L. Alsus*, are far from common; *M. Artemis* was recorded as having been once taken near Eastham, till last year (1882), when I saw it in great abundance near Malpas *A. Selene*, *T. Quercus*, and *T. Rubi*, I have never seen in our district, though they have occurred in it, and I can find no record of the occurrence of *L. Alveolus* in it.

Of the 22 species which are confined to the more Southern parts of the Island, *G. Rhamni* occurs occasionally in our district. The range, however, of this insect does appear to be determined by its food plant, as neither species of *Rhamnus* is found (according to Watson) in Lancashire or Cheshire. One species is, however, found in Flintshire, but it is rare. *C. Edusa* is found abundantly in some years, *e.g.*, in 1877; *H. Tithonus* is tolerably common; *V. Polychloros* is recorded by MR. BROCKHOLES (one specimen) and MR. GREENING; *G. C.-album* is occasionally taken all over the district, but seems to be becoming scarcer; *A. Paphia* is found in Flintshire and Denbighshire; *L. Ægon* is found at Bidston and Delamere; and *P. Linea* has been taken at Eastham. This makes 8 of the 22 Southern species which reach our district.

Of the 3 Northern species we have only *C. Davus*, which is found at Delamere and near Minera; of the 7 local species, none; and of the 3 "Stragglers" only *V. Antiopa*, which was taken in 1872 both by MR. BROCKHOLES at Neston, and by MR. F. LEATHER at Delamere.

	In Gt. Britain.		Chester District.
Species generally distributed	28	..	27
Southern Species	22	..	8
Northern ,, ...	3	..	1
Local ,, ...	7	..	—
Stragglers	3	..	1
	63		37

Of the total number (63) of species occurring in Great Britain, 37, or 58·7 % have been found in our district. On the other hand, the *S. Eastern Counties of Kent, Surrey, Sussex, and Hants, and again, the S. Midland Counties of Herts, Bucks, Oxford, Northampton, Huntingdon, Bedford, and Cambridge, have 57 species, or over 90 %; and the Eastern Counties of Essex, Suffolk, and Norfolk, have 56 species; while the S. Western Counties of Wilts, Dorset, Devon, Somerset, and Cornwall, though in part lying farthest S., and with a much more genial winter climate, have only 52, and I have no doubt that the species found in Devon and Cornwall alone are considerably fewer.

We find therefore that there is a falling off in the number of species as we go from E. to W., and still greater as we go N.W. rather than N., for Yorkshire has (excluding extinct species) 46 against our 37. Now if we look on the Continent we shall

* These groups are the divisions adopted in Symon's British Rainfall.

find the same law holds good. Belgium for instance has, according to STAINTON (Trans. Ent. Society of London), 94 species, while in Silesia there are 124 species. The number also diminishes from S. to N., but not in the same proportion, for there are said to be 77 species in Lapland, while in Scotland there are only 34.

What is, then, the cause of this decrease in the number of species as we go Westward? We may, I think, dismiss the Geological view, for granting that during the Glacial period the Northern and N. Western portion of the Island remained submerged longer than the S. Eastern, there is no reason why Butterflies with such powerful wings as *A. Iris* and *L. Sibylla* should not have migrated North when the feeble *C. Phlœas* and *L. Alsus* did so, unless other causes prevented them. Nor can it be want of the suitable food plants for the larvæ, for as a general rule these are sufficiently abundant in the districts where the insects do not occur. In the case of the two first Butterflies mentioned above the food plants are poplar and willow, and honeysuckle, all surely common enough in our district.

The only remaining cause which appears to me probable is climate, and it remains for us to consider in what manner this can influence the distribution of Lepidoptera. Most people are aware that owing to the position of these Islands on the extreme West of the Continent of Europe, they are the first to encounter the moisture-laden winds that sweep across the Atlantic. These, on reaching the high lands that fringe our Western shores, are partially condensed into clouds and rain, and pass on Eastwards, parting with more and more moisture as they go, till as they reach the centre and East of Europe comparatively little moisture is left in the atmosphere. The consequence of this is that not only is the rainfall greater, but, owing to the power of aqueous vapour to absorb radiant heat, the sun's rays have much less power in this country (and especially on the Western side of the Island) than further to the East. And the same power of checking radiation causes the cold in winter to be as much greater to the E. as is the heat in summer. As, however, we are only concerned with the summer temperature, we need not concern ourselves with this last point.

If the above statement be true, we should expect to find the *day* temperature in summer increasing as we go from W. to E., and this is precisely what takes place, and to an extent, considering the narrow limits of our Island, that is somewhat surprising. In order to illustrate this point I have selected four places from the list published by MR. GLAISHER in his Quarterly Returns. These are—

1.—Blackheath, in Kent,	representing	S.E.	England.
2.—Plymouth	,,	S.W.	,,
3.—Leeds	,,	N.E.	,,
4.—Liverpool	,,	N.W.	,,

I might, of course, have gone further N. than Leeds and Liverpool, but the latter represents the climate of our own district (Bidston Observatory being in Cheshire), and Leeds the climate further inland and somewhat to the N.E. Taking then the *mean maximum* temperature for the three summer months of June, July, and August, for the five last years (1878-82), I find the averages to be as follows:—

Blackheath.	Plymouth.	Leeds.	Liverpool.
69°.5	66°.4	68°.1	64°.2

So that we find Blackheath to be hotter than Plymouth by 3°.1, and Leeds not only hotter than Liverpool by nearly 4°, but actually hotter than Plymouth, nearly 250 miles further south, by 1°.7! And as these differences may seem trifling to those who are not accustomed to compare mean temperatures, it may give them some idea of what they mean when I say that the difference between the decidedly warm summer of 1878, and the extraordinarily cold summer of 1879 (these being the two extremes in the five years), was only 4°.2 on the mean maxima, while the *average* difference between Liverpool and Blackheath is 5°.3!

We may therefore take as established the following facts, which indeed no Meteorologist would dispute, viz.:—

1.—That the West of England has a moister atmosphere and greater rainfall than the E.

2.—That the day temperature in summer increases rapidly from N.W. to S.E.

Now I have already shown that the number of species of Butterflies also increases rapidly as we go from N.W. to S.E., and I therefore submit that until reasons be shown to the contrary, we are justified in considering that there is a direct connection between the two sets of facts.

It remains to be considered why a moister and colder climate in summer should diminish the number of Lepidoptera. And I must be allowed here to express my satisfaction at finding that so experienced an Entomologist as Mr. B. Cooke has independently arrived at almost the same conclusions, as shown in a paper read by him before this Society (Lancashire and Cheshire Ent.) last year. In a paper I read before the Chester Society of Natural Science in 1875, I suggested that insufficient ripening of the wood of trees and shrubs from want of solar heat would produce a condition of the leaves injurious to the health of the larvæ, and I enlarged on this in another paper read in 1876. But as these papers were not published (except possibly in the local newspapers), and have been in my possession ever since, Mr. Cooke could not have seen them—moreover he attributes the unwholesome condition of the food to excessive rain, which undoubtedly is a most important element in that respect.

As regards the Diurnal Lepidoptera, it is probable that the greater number of species, while able to endure extreme cold in the egg and pupa condition, absolutely require a high temperature to enable them to breed, if not to exist, in the imago state. In their case, therefore, we need go no further than the direct effect of the sun's heat upon the perfect insect.

But we have now to consider the Nocturnal Lepidoptera, and it is at once obvious that the above consideration will not apply to them. Yet there seems to be no doubt that in certain orders the number of species of these also diminish from E. to W. The question therefore arises in what manner are these insects affected by the climatic conditions stated above.

It is quite possible that very excessive rains, especially at night, may affect the perfect insect, but I think that as a rule these keep under cover of leaves, &c., while heavy rain is falling, and thus escape injury. In the pupa state I believe that much more damage is suffered from damp both in summer and winter than from cold in winter. MR. DOUBLEDAY, lamenting the scarcity of Lepidoptera in 1863, says "Our only hope lies in the advent of a hard winter followed by a succession of hot summers and autumns" (Ent. Ann. 1864, p. 119.) This then is one of the probable causes operating against an abundance of this class of insects in the West, where, as already shown, the winters are milder and therefore damper than in the East.

But it is in the larva state that I am disposed to think climatic influences are most powerful. It is tolerably well known (though less so than it should be) that after a cold and wet summer there will be a poor crop of tree fruits, such as pears, apples, and plums. This is caused by the wood not having been sufficiently hardened or ripened owing to its being kept in a continually growing state by the moisture without sufficient heat. This leads to an unhealthy condition of the tree which prevents it bearing, or at all events bringing to maturity, much fruit. Now it appears to me that the same conditions may act injuriously on the larvæ that feed on trees and shrubs which are in this condition. No breeder of Lepidoptera would think of feeding his larvæ on the very young and sappy leaves of their food plant if that happens to be a tree, and it is only reasonable to suppose that in their natural state unripe leaves would have an injurious effect. I question whether those larvæ that feed on herbaceous plants, which are naturally of a juicy nature, would suffer to the same extent from cold and wet in summer, though I can hardly doubt that they must do so in some degree.

If the above view is correct we ought to find that Lepidoptera, especially those which feed on trees and shrubs, ought to be more numerous in a drier and colder climate, and I shall show that even at so short a distance from us as York there is a marked increase in the number of species, and also that we have in our district a smaller percentage of the total number of species occurring in Great Britain which feed on trees, &c., than we have of those which live on herbaceous plants.

To commence again with the Butterflies, we have 58% of all the species occurring in Great Britain. But of those that feed on herbaceous plants (hereafter called "plant-eaters") we have 71%, against 36% of those that feed on trees or shrubs (hereafter called "tree-eaters.") Indeed we have only 4 species of the latter class, and of these *G. Rhamni* is scarce, *V. Polychloros* very rare, and *L. Argiolus* and *T. Quercus* very far from common. *G. C-album* and *T. Rubi* feed both on plants and shrubs, but the former though generally distributed is far from common, and the latter is only recorded from the E. side of our district. I have however met with it in Merionethshire, near Bala Lake. In Yorkshire, *G. Rhamni* is "of general occurrence"; *V. Polychloros* "not uncommon"; *T. Rubi* occurs in 5, and *T. Quercus* in 10 localities; and *T. W.-album* (another tree-feeder) in 4, in 2 of which it is abundant.

Passing by the *Sphingina* with the remark that we have 16 species, of which only 2 (*S. ocellatus* and *S. Populi*) are tree-feeders, while Yorkshire has 18 with 3 tree-feeders, we come to the *Bombycina*, in which I include, after Stainton, the *Hepialidæ Pseudo-Bombyces*, &c. Of the 101 species of this class we have 56, and of these, omitting such as the lichen-eating *Lithosidæ*, 18 out of a total 25, or 72%, are plant-eaters, and 29 out of a total 57, say 50%, are tree-eaters. Yorkshire has 68 species, of which 38, or nearly 67%, are tree-feeders, and 17, or 68%, plant-feeders. With the exception of *P. auriflua* and *O. antiqua*, none of the tree-feeders can be considered common in this district.

To the next family—the *Noctuina*—belong the bulk of the *Macro-Lepidoptera* of the Chester district, whether we consider species or individuals. Of the 294 species in Great Britain we have 59½%. Of the 212 species that feed on plants we have 134, or 63%. Of the 63 species that feed on trees we have 30, or 47%. I have not gone through the species that occur in Yorkshire, but in the tree feeding genus *Cymatophora* we have but 2 species, both rare, against 6 species in Yorkshire.

I will not pursue the comparison further, but the annexed table will show that in all the orders the number of species in Yorkshire much exceeds that in our district.

	Chester District.		Yorkshire.
Diurni	37	..	46
Sphingina	18	..	26
Bombycina	56	..	68
Noctuina	184	..	224
Geometrina	165	..	205
Pyralidina	69	..	97

Macrolepidoptera of the Chester District.

EDITED BY ALFRED O. WALKER.

THE following list of the Macrolepidoptera of the district adopted by the Chester Society of Natural Science, viz., Cheshire west of Warrington, with the Counties of Flint and Denbigh, is founded on the late Mr. J. F. BROCKHOLES's list of the Lepidoptera of Wirral, who entrusted the present Editor with his manuscript. The localities in Wirral are given on his authority, except where otherwise stated. Other contributors (whom I take this opportunity of thanking for their assistance) are the following, their contributions being indicated in the list by the letters or abbreviations following each name:—

- The late Mr. NOAH GREENING, Warrington (*E.* = East of district.)
- Mr. G. A. ALMOND, formerly of Birkenhead (*Al.*) Communicated by Mr. F. ARCHER. All captures at the Loggerheads are given on his authority.
- Mr. F. LEATHER, Delamere Lodge (*L.*)
- Mr. WILLOUGHBY GARDNER, Oxton, Birkenhead (*W.G.*)
- Mr. G. DAY, Chester (*Day*).
- Mr. FRANK ARCHER, Crosby (*F.A.*)
- Mr. NEWSTEAD, Chester (*N.*)
- Ent. = The Entomologist.

Other names are given in full, and where no authority is given the Editor is himself responsible for the locality, &c.

As the classification of Stainton's Manual was adopted by Mr. BROCKHOLES, it has been found more convenient to adhere to it.

The Editor is in possession of Mr. BROCKHOLES's list of the Microlepidoptera of Wirral and a marked list of those of the Warrington neighbourhood from the late Mr. GREENING; but in the complete absence of any list from the Welsh side, he has thought it advisable to defer their publication for the present. He will be thankful to any Entomologist who will kindly send lists of unrecorded species of Macros taken in the above district, or of any Micros taken in Flintshire or Denbighshire.

ALFRED O. WALKER.

RHOPALOCERA.

Localities in square brackets, thus [ ] are outside the District.

Since the following List was sent to the Printers, Dr. J. W. ELLIS has begun a List of the Lepidoptera of Lancashire and Cheshire in *The Naturalist* for 1885, p. 163, in which additional localities and species will no doubt be found.

Gonepteryx Rhamni. Upton, nr. Birkenhead (*Al.*) Denhall (*J.F.B.*). Holywell (*F.A.*). Beeston Castle and Chester (*Day*). Delamere (*L.*) E. [Llandudno—Harding in Ent. Vol. xv. page 64.]

Colias Edusa. Occasionally met with throughout the district. Abundant everywhere in June and September, 1877.

Pieris Brassicæ
,, *Rapæ* } Common everywhere.
,, *Napi*

Anthocaris Cardamines. Tolerably common.

Leucophasia Sinapis. Plantation between Hooton Station and Mollington (Gregson—Naturalist 1885 p. 165.)

Lasiommata Ægeria. Sparingly at Prenton, Denhall, and Puddington. Common in woods in Flintshire and Denbighshire. Queensferry (*Al.*), E.

,, *Megæra.* Common.

Hipparchia Semele. Common on sandhills at Rhyl, Wallasey, &c.; also on Limestone rocks at the Loggerheads, Ysceifiog, Talargoch.

,, *Janira.* Common.

,, *Tithonus.* Not very common. Guilden Sutton; Willington.

,, *Hyperanthus.* Woods near Llyn Helig, Flintshire. Delamere (*L.*)

Cœnonympha Davus. Clark's Moss, Delamere. Minera Mountain.

,, *Pamphilus.* Common.

Cynthia Cardui. Sparingly throughout the district. Seems to prefer high and exposed situations, as the tops of mountains, river embankments, &c.

Vanessa Atalanta. } Common.
,, *Io.*

,, *Antiopa.* Prenton, Neston; Delamere (*L.*), all in 1872.

,, *Polychloros.* Very rare; one at Prenton (*J.F.B.*). Chester 1859. Delamere. Eastham (Naturalist 1885, p. 168). E. [Llandudno (Harding in Ent. xv., p. 64.)]

,, *Urticæ.* Common.

Grapta C-album. Scarce in Wirral. Delamere (*L.*). Chester; Holywell; Ruabon; Colwyn Bay. E.

Argynnis Paphia. Holywell and Bagillt; Nant-y-Glyn, Colwyn.

,, *Aglaia.* Wallasey Sand Hills; Ness; Burton. Wood near Rock Tavern, Holywell. Abergele (*W.G.*)

[,, *Adippe.* Gt. Orme, Llandudno (Harding in Ent. xv., p. 65.)]

RHOPALOCERA—*Continued.*

Argynnis Selene. Delamere (*L.*). Bettws-y-Coed (*W.G.*). [Llandudno—Harding l. c.]

,, *Euphrosyne.* Near Holywell. Bathafarn, near Ruthin, rather common. Colwyn, com. E.

Melitæa Artemis. One near Eastham (*S. Archer.*) Abundant at the Wyches, near Malpas, in 1882.

Thecla Quercus. Eastham Wood, Delamere (*L.*), Gresford (*F.A.* and *Mr. Acton.*), Edge nr. Malpas (*C. W. Dod*), Conway Valley (*W.G.*) [Llandudno—Harding, l. c.]

[*Nemeobius Lucina* is said to occur in a lane near Gloddaeth, Llandudno—Harding, l. c.]

Thecla Rubi. Abundant near Bettws-y-Coed (*F.A.*). E. [On the Twrch, Llanuwchllyn, Bala Lake.] [Llandudno—Harding, l. c.]

Chrysophanus Phlæas. Common.

Lycæna Argiolus. Lanes above Bagillt. Nr. Ruthin. Colwyn. E.

,, *Alsus.* Bagillt. Loggerheads. Talargoch.

,, *Arion.* Said to have been seen on tramway by Aston Hall Colliery. Westwood says it is recorded as occurring in some parts of N. Wales on Bramble blossoms (Brit. Butterflies by Humphreys and Westwood, p. 104.)

,, *Alexis.* Common.

,, *Ægon.* Bidston Hill; Claughton; Delamere. E.

,, *Agestis.* Wood nr. Llyn Helig. Talargoch nr. Rhyl. Bryn Eurin, Llandrillo-yn-rhos (*W.G.*)

Thanaos Tages. Wirral. Bagillt. Colwyn Bay. E. The larva hybernates in a case formed by spinning together grass stems.

Pamphila linea. Eastham (*F.A.*). Sutton. Raby Mere (*W.G.*) [Llandudno—Harding, l. c.]

,, *Sylvanus.* Between Raby & Bromborough. Bagillt. E.

HETEROCERA.

SPHINGINA.

Procris Statices. Delamere (*L.*)

[,, *Geryon.* Orme's Head, Llandudno, very common in 1881 (*W.G.*)]

Anthrocera Trifolii. Bagillt. The Wyches, Malpas.

,, *Loniceræ.* Bidston. (*J.F.B.* & *N. Cooke.*) It seems very doubtful whether the two last species are distinct.

,, *Filipendulæ.* Occurs throughout the district, but local.

Smerinthus ocellatus. Larvæ common on Willow, Bagillt. The Bache, Chester (*Day*). Delamere (*L.*). E.

,, *Populi.* Bagillt; Chester; Delamere. E.

Acherontia Atropos. Christleton, 1858. Tattenhall (*Manning*). Delamere (*L.*). Saughall (*Shrubsole*). Larvæ not uncommon at Upton, nr. Birkenhead. (*F.A.*). Bagillt.

HETEROCERA—SPHINGINA—*Continued.*

Sphinx Convolvuli. Bagillt, 1859. Eaton Park, 1873. Oxton; Denhall.

,, *Ligustri.* Larva said to have occurred at Oulton (*L.*)

Deilephila Galii. Larvæ taken pretty freely on Wallasey Sandhills, 1870 (*J.F.B.*)

Chœrocampa Elpenor. Wirral. Delamere (*L.*). E.

,, *porcellus.* Wallasey Sandhills. Delamere (*L.*) Rhyl. E.

Macroglossa stellatarum. Common.

Sesia fuciformis. Bidston, scarce.

Spechia bembeciformis. Common in N. Wirral. Marsh land between Bagillt and Greenfield, 1857 (*F.A.*). The Nurseries, Upton. E.

Trochilium scoliæforme. Llangollen (*Ashworth*)

,, *tipuliforme.* Hough Green, Chester (*Day*). Wirral, not uncom. (*W.G.*). Larva common in currant twigs at Leadworks, Chester, 1884.

Hepialus hectus. Common.

,, *lupulinus.* Do.

,, *Humuli.* Do.

,, *Velleda.* Eastham Wood. Holywell. Loggerheads. Bathafarn, nr. Ruthin. E. Colwyn.

,, *sylvinus.* Rather common in lanes.

Cossus ligniperda. Wirral, not com. At Sugar, nr. Holywell (*J.F.B.*); Delamere (*L.*) E.

Cerura furcula. Wirral, scarce. Delamere (*L.*). E.

,, *bifida.* Wirral. Chester (*Day*). Holywell (*J.F.B.*). E.

,, *vinula.* Not very common.

Notodonta dromedarius. Wirral, not common. Larva on hazel, Colwyn Bay. E.

,, *ziczac.* Wirral. Larvæ com. nr. Holywell. Delamere (*L.*)

Pterostoma palpina. Puddington—1 specimen.

Leiocampa dictæa. Wirral. Holywell. E.

,, *dictæoides.* Bidston, scarce. E.

Drymonia chaonia. Eastham Wood—1 spn. (*N. Cooke.*)

,, *Dodonæa.* E.

Lophoptery Camelina. Throughout the district, but not very com.

Diloba cœruleocephala. Bidston; Puddington, scarce. Colwyn Bay—larva on pear, June, '79. E.

Petusa cassinea. E.

Peridea trepida. E.

Pygæra bucephala. Throughout the district, but not very common.

Dasychira fascelina. Wallasey Sandhills, common; scarcer inland. Sandhills on E. side of Conway, 1884.

,, *pudibunda.* Throughout the district, but not very common.

Demas Coryli. Larva nr. Holywell (*F.A.*)

Orgyia antiqua. Common everywhere.

Stilpnotia salicis. Wallasey; Bidston. Hoylake (*F.A.*). Loggerheads.

Porthesia chrysorrhœa. Burwardsley—probably sometimes confounded with the next.

HETEROCERA—SPHINGINA—*Continued.*

Porthesia auriflua. Common everywhere.
Lithosia stramineola. Lane near Dunham-on-the-Hill.
,, *complana.* Wallasey; Bidston, scarce. E.
,, *complanula.* Wirral—not com. Chester (*Manning*). Delamere (*L.*) Loggerheads.
Gnophria rubricollis. Bathafarn, nr. Ruthin, 1862. E.
Cybosia mesomella. E.
Nudaria mundana. Throughout the district.
Euthemonia Russula. Delamere (*L.*) E.
Arctia caja. Common—larvæ a pest in gardens 1882.
,, *villica.* Delamere (*L.*)
Nemeophila plantaginis. Loggerheads; Cyrn-y-brain (?) 1878; Colwyn, 1884.
Phragmatobia fuliginosa. Throughout the district.
Spilosoma menthastri. Very common.
,, *lubricepeda.* Less common than the preceding.
Diaphora mendica. Tranmere. Colwyn Bay, 1879. E.
**Callimorpha Jacobææ.* Wallasey. Chester; Holywell; Rhyl; &c. Most abundant on sandhills all along the coast.
Lasiocampa Rubi. Wallasey; Bidston. Loggerheads. Colwyn. E. Probably occurs throughout the district on heaths.
,, *Trifolii.* Wallasey sandhills.
,, *Quercus.* Throughout the district.
Eriogaster lanestris. Upton nr. Birkenhead. West Kirby (*Day.*) Chester. Cwm nr. Holywell. Loggerheads. Colwyn.
Pæcilocampa populi. Bidston. Loggerheads. Bettws-y-Coed. E.
Trichiura Cratægi. Reared from larva found at Saighton by Miss H. Smith, Hampton Lodge, Chester.
Clisiocampa neustria. Upton Valley; Ness. Colwyn (*F.A.*)
Odonestis potatoria. Common.
Saturnia Pavonia-minor. Heaths throughout the district.
Cilix spinula. Wirral. Delamere. Chester; fresh specimens July 27 and 28, 1859. None seen between that date and May. E.
Platypteryx lacertinaria. E.
Drepana falcataria. E.
Fumea nitidella. Patrick Wood, Bromborough. Lower Bebington (*F.A.*) Holywell (larva.)

NOCTUINA.

Thyatira derasa. Not uncommon.
,, *Batis.* Near Holywell; Eastham; Puddington. Chester (*Day*). Colwyn 1884.
Cymatophora duplaris. Prenton Wood, scarce. Gresford (*F.A.*)
,, *flavicornis.* Bidston Park Wood, scarce. E.
Bryophila perla. Wirral. Chester City Walls. Bagillt. E.

*Note.—*Callimorpha Hera* and *Eulepia grammica* are both said to have been taken at the same time and by the same person between Ruabon and Wrexham, in July, 1859—Zoologist, 1862, p. 7912, but further evidence is required.

NOCTUINA—*Continued.*

Acronycta trideus. Wallasey; Ness; scarce. Chester (*Miss S.*) E.
,, *Psi.* Tolerably common.
,, *leporina.* Bidston—scarce. Llyn Helig; Whitford (*F.A.*) E.
,, *megacephala.* Common.
,, *Alni.* Delamere—larva (*L.*) 1877. E.
,, *ligustri.* Old Marsh Lane, Ince (N.)
,, *Rumicis.* Common.
,, *Aceris.* Delamere (*L.*)
Leucania conigera. Ness. Rock Ferry (*Al.*) Holywell (*F.A.*) Bathafarn. Colwyn—common.
,, *lithargyria.* Common.
,, *littoralis.* Wallasey Sandhills. Rhyl.
,, *comma.* Wirral. Ince (*N.*) Chester. Holywell. Rhyl.
,, *impura.* Very common.
,, *pallens.* Not so common as last species—none seen 1858 or '59 by A.O.W.
,, *Phragmitidis.* The Lead Works, Chester, Aug. 11, 1858, at light.
Nonagria despecta. Little Neston; Ledsham.
,, *fulva.* Bidston Marsh; Tranmere; Puddington. Chester. E. Mostyn (*N.*) Hatchmere.
,, *Typhæ.* Common.
,, *crassicornis.* Bidston Marsh; Burton; scarce at Ness and Puddington.
Gortyna flavago. Birkenhead—becoming scarcer. Ince (*N.*) larvæ common. E.
Hydræcia nictitans. Wallasey and Seacombe, common; Claughton—1 specimen; Denhall. Hatchmere. E.
,, *Petasitis.* E.
,, *micacea.* Wirral. Chester. Bagillt Hall. Loggerheads. E.
Axylia putris. Common.
Xylophasia rurea. Common; also var. *Combusta.*
,, *lithoxylea.* Common.
,, *polyodon.* Very common: a black variety taken at the Lead Works, Chester.
,, *hepatica.* Puddington. Holywell, common.
Neuria Saponariæ. Denhall, scarce. Delamere (*L.*)
Heliophobus popularis. Wirral. Chester. Delamere (*L.*) E.
Charæas graminis. Wallasey; Ness; Burton. Loggerheads. Cwm Mountain (*F.A.*). Cyrn-y-brain, nr. Llangollen; Helsby. Delamere (*L.*)
Cerigo cytherea. Wirral. E.
Luperina testacea. Wirral. E.
,, *cespitis.* Wallasey. E.
Mamestra abjecta. Claughton; Ness; Puddington—scarce. Bagillt; Holywell.
,, *anceps.* Wirral. Holywell. Colwyn. E.
,, *albicolon.* Wallasey Sandhills. Rhyl.
,, *furva.* Loggerheads. [Orme's Head.]
,, *Brassicæ.* Very common—larva a sad garden pest.

NOCTUINA—*Continued.*

Mamestra Persicariæ. Larva common on Pteris aquilina nr. Holywell. E.
Apamea basilinea. Rather common.
,, *gemina.* Rather common.
,, ,, *var. oblonga.* Wallasey—scarce.
,, *unanimis.* Wallasey; Rock Ferry; Puddington. E. Loggerheads. Chester—rather common (1858).
,, *oculea.* Very common.
Miana strigilis. Very common.
,, *faseiuncula.* Wirral. Chester, common (1858). Loggerheads. Colwyn. E.
,, *literosa.* Wallasey Sandhills; Denhall. Chester. Helsby. Loggerheads. E.
,, *furuneula.* Wallasey; Ness; Burton. Chester. E.
,, *arcuosa.* Bidston Marsh; Puddington, scarce. Holywell.
Celæna Haworthii. Gwern, Minera nr. Wrexham (1859). E.
Grammesia trilinea. Occurs throughout the district.
,, ,, *var. bilinea.* Rock Ferry; less frequent elsewhere.
Caradrina Morpheus. Wallasey; Denhall. Chester (*Day.*) Delamere (*L.*) Loggerheads. Bagillt. Rhyl. Colwyn. E.
,, *Alsines.* Wallasey; Bromborough, scarce. Colwyn.
,, *blanda.* Wirral. Loggerheads. Bathafarn. Rhyl. Colwyn.
,, *cubicularis.* Very common.
Rusina tenebrosa. Wallasey; Bidston; Ness; Burton, scarce. Holywell. Loggerheads. Colwyn. E.
Agrotis valligera. Wallasey Sandhills. Rhyl. [Llandudno.]
,, *puta.* Near Wallasey—1 specimen. Stourton Wood (*W.G.*)
,, *suffusa.* Wirral. Holywell. Colwyn.
,, *saucia.* Bidston; Upton Valley; Eastham Wood; Ness. Colwyn.
,, *segetum.* Common.
[,, *lunigera.* Llandudno—1 specimen.]
,, *exclamationis.* Common.
,, *corticea.* Wallasey. Holywell. Colwyn.
,, *ripæ.* Rhyl at sugar, 1857.
,, *cursoria.* Wallasey Sandhills; formerly more plentiful; Denhall—1 spn. [Mouth of Conway River (*W.G.*)]
,, *nigricans.* Occasionally taken; Wallasey Sandhills; Denhall.
,, *Tritici.* Wallasey; Denhall. Rhyl. Chester (*Day.*)
,, *aquilina.* Occasionally on Wallasey Sandhills; Denhall, scarce.
,, *obelisca.* Wallasey Sandhills—scarce (*N. Cooke.*)
,, *agathina.* Wallasey Sandhills 1 spn. in 1864 (*Al.*)
,, *porphyrea.* Bidston Hill; Claughton fir wood; Prenton Mount Wood. Loggerheads. Moel Fammau. E.
,, *præcox.* Wirral, not abundant.
,, *pyrophila.* Holywell (*F.A.*). Loggerheads.
,, *lucernea.* Loggerheads.

NOCTUINA—*Continued.*

Agrotis Ashworthii. Llangollen (*Ashworth*). Loggerheads.
Triphæna Ianthina. Wirral, not abundant. Chester. Holywell. E.
,, *fimbria.* Wallasey; Claughton; Eastham Wood; Denhall; Puddington, scarce. The Groves, Chester (*Day.*) Holywell.
,, *interjecta.* Wallasey; Rock Ferry, scarce. Chester(*Day*). E.
,, *orbona.* Common.
,, *pronuba.* Extremely common.
Noctua glareosa. Ness, scarce. Loggerheads. E.
,, *augur.* Wirral. Holywell. Chester (*Day.*) E.
,, *plecta.* Common—occurs both in June and August.
,, *C-nigrum.* Wallasey, abundant. Holywell. Chester (*Day.*) Ince. Colwyn. E. Not generally common.
,, *triangulum.* Wirral, not very common. Rhyl. Chester (*Day.*)
,, *brunnea.* Scarce, Bidston; Rock Ferry; Burton. Holywell. Loggerheads. E.
,, *festiva.* Rather common.
,, *bella.* Common.
,, *umbrosa.* Common.
,, *Baja.* Wirral. Holywell. Loggerheads. E.
,, *Xanthographa.* Very common.
Trachea piniperda. Wirral. Llyn Helig. Cwm Mountain (*F.A.*) Loggerheads. E.
Tæniocampa gothica. Common at Sallows
,, *rubricosa.* Wirral. Bagillt. Bathafarn. E.
,, *instabilis.* Common.
,, *opima.* Wallasey; Leasowe; Bidston; not abundant.
,, *populeti.* Wirral, scarce but generally distributed.
,, *stabilis.* The commonest of the genus.
,, *gracilis.* Wirral. Marsh land nr. Bagillt. E.
,, *munda.* Bromborough; Eastham; Puddington. E.
,, *cruda.* Common.
Orthosia upsilon. Wallasey. E.
,, *lota.* Common.
,, *macilenta.* Rock Ferry; Eastham; Puddington. Holywell. Colwyn, common.
Anthocelis rufina. Wirral, rather scarce. Holywell (*F.A.*) Loggerheads. Llangollen. Colwyn. E.
,, *pistacina.* Not uncommon.
,, *lunosa.* Wirral. Lead Works, Chester.
,, *litura.* Common.
Cerastis Vaccinii Common.
,, *spadicea.* Wirral. Chester. Holywell (*F.A.*) Loggerheads. E.
Scopelosoma satellitia. Common.
Xanthia citrago. Rock Ferry; Puddington. Chester (*Day*). Loggerheads.

NOCTUINA—*Continued.*

Xanthia cerago. Wirral. Chester. Holywell. E.
,, *flavago.* Bidston; Claughton; Tranmere; Puddington. Loggerheads. E.
,, *gilvago.* Ness; Puddington—scarce.
,, *ferruginea.* Common.
Cirrœdia xerampelina. Denhall—1 specimen (*J.F.B.*)
Tethea subtusa. Wallasey; Bidston; Tranmere; Puddington—not common. Llangollen.
Cosmia trapezina. Wirral. Holywell. E.
Dianthœcia carpophaga. Denhall—rather scarce. Holywell (larvæ). Northop (*W.G.*)
,, *capsincola.* Wirral. Holywell (larvæ) common. E.
,, *cucubali.* Wallasey; Puddington—scarce; Colwyn 1884. E.
,, *conspersa.* Tranmere, 1 specimen by Mr. Warrington.
Hecatera serena. Ness; Burton; Cappenhurst. Loggerheads. Holywell. Rhyl. [Llandudno].
Polia Chi. Bidston; Ness; Burton; Puddington. Loggerheads. Holywell.
Dasypolia Templi. Bidston Lighthouse, 1 specimen (*J.F.B.*)
Epunda lutulenta. Wirral; Chester; scarce.
,, *nigra.* Nant-y-Glyn, Colwyn—abundant at sugar and Arbutus flowers.
,, *viminalis.* Loggerheads.
,, *lichenea.* Wallasey. Bidston (*Al.*) E.
Miselia Oxyacanthæ. Common.
Agriopis Aprilina. Bidston; Rock Ferry; Eastham; Puddington; Ness. Holywell. Colwyn. Llangollen. E. Not very common.
Phlogophora meticulosa. Very common.
Euplexia lucipara. Rather common.
Aplecta herbida. Ledsham. Loggerheads. Colwyn—1 specimen, 1884.
,, *occulta.* Claughton; Denhall—rare. Delamere (*L.*)
,, *nebulosa.* Bromborough (*Al.*); Eastham Wood; Ledsham. Holywell. Loggerheads. Delamere (*L.*) E. By no means common.
,, *advena.* Holywell. Loggerheads. Bathafarn. Colwyn.
Hadena adusta. Wallasey; Puddington. Loggerheads. E.
,, *protea.* Rock Ferry; Puddington. Holywell. E.
,, *glauca.* Delamere (*L.*) E.
,, *dentina.* Wirral. Llyn Helig. Loggerheads. Bathafarn. Delamere (*L.*) E. Colwyn.
,, *suasa.* Wallasey; Bidston Marsh; scarce. More frequent at Denhall. Holywell.
,, *oleracea.* A garden pest.
,, *Pisi.* Wirral—most abundant nr. New Ferry. Loggerheads. Rhyl. Holywell; larvæ abundant on willows nr. Bagillt. E.
,, *Chenopodii.* Denhall—1 specn. in 1870 (*J.F.B.*)

NOCTUINA—*Continued.*

Hadena Thalassina. Wallasey; Rock Ferry; Puddington. Chester; Holywell. E.
 ,, *contigua.* Rock Ferry—1 spn. in 1860 (*J.F.B.*)
Xylocampa lithorhiza. Wirral. E. (?) Helsby (*N.*)
Calocampa vetusta. Wallasey; Bidston; Upton; scarce. Holywell. Delamere.
 ,, *exoleta.* Wirral, not abundant. Chester. Loggerheads. Llangollen. Colwyn. Ince. E.
Xylina rhizolitha. Upton; Denhall; scarce. Colwyn.
Cucullia Chamomillæ. Bidston; Denhall; scarce.
 ,, *umbratica.* Wallasey; Bidston; Ness. Chester. Holywell. Rhyl. E. Generally scarce. [Llandudno. Porritt in Ent. xiv. 216.]
Heliothis marginata. Wallasey; New Ferry; generally scarce. Rhyl.
 ,, *armigera.* One specimen in 1857 on salt marsh nr. the mouth of Bromborough Pool (*Al.*)
Anarta Myrtilli. Wirral. Loggerheads. Delamere. E.
Heliodes Arbuti. Prenton Lane; Puddington. Chester (*Manning*). Beeston Castle (*Day*). Bagillt. Loggerheads. E.
Brephos Parthenias. Between Minera amd Llangollen (*Day*). E.
Abrostola Urticæ. Holywell at flowers of Centranthus ruber. Ince (*N.*)
 ,, *triplasia.* Wallasey; Tranmere; Oxton; Ness; Puddington; scarce. Chester. Ince (*N.*). Holywell. Colwyn, at Centranthus. E.
Plusia Chrysitis. Very common.
 ,, *Festucæ.* Round Birkenhead; Puddington. Chester.
 ,, *Iota.* Puddington. Holywell, common. Chester. Ince (*N.*) E.
 ,, *pulchrina.* Puddington—seems scarce. Rock Ferry (*W.G.*). Chester. Loggerheads. Holywell. Ince (*N.*) E.
 ,, *gamma.* Very common.
 ,, *interrogationis.* Llangollen (Stainton's Manual.)
Gonoptera libatrix. Wirral, rather scarce. Tolerably common in most parts of the district.
Amphipyra pyramidea. Puddington—1 specimen in 1870.
 ,, *Tragopoginis.* Common.
Mania typica. Common.
 ,, *Maura.* Rather common.
Stilbia anomala. Holywell (*F.A.*) Talacre (*J.F.B.*)
Catocala Fraxini. Eastham, and Upton Road, Birkenhead (*Ellis.*)
Euclidia Mi. Wallasey Sandhills—scarce. Woods nr. Llyn Helig (*F.A.*) Bagillt. Loggerheads. Colwyn. E.
 ,, *glyphica.* Eastham (*F.A.*) Shotwick (*Al.*) Chester (*Manning.*) Beeston (*Day.*) Bagillt. Loggerheads. Colwyn. E.
Phytometra Ænea. Bidston Hill. Colwyn. E. [Trefriw.]

GEOMETRINA.

Ourapteryx sambucaria. Common.

Epione apiciaria. Wallasey; Rock Ferry; Denhall; Puddington; not common. Chester. Holywell. Loggerheads. E.

Rumia Cratægata. Extremely common.

Venilia maculata. Colwyn.

Metrocampa margaritata. Rather common.

Ellopia fasciaria. Prenton; Ness; Burton; scarce. Llyn Helig. Cwm Mountain. Loggerheads. Wood nr. Bagillt. Delamere. E.

Eurymene dolubrata. Rock Ferry. Eastham Wood (*Al.*) Scarce. E.

Pericallia syringaria. Denhall, scarce. Newton, Chester. Holywell (*F.A.*) Ince (*N.*) E.

Selenia illunaria. Common.

,, *lunaria.* Rock Ferry; Puddington. Holywell (*F.A.*) Scarce.

Odontoptera bidentata. Wirral. Chester. Bagillt. Loggerheads. Colwyn. E.

Crocullis elinguaria. Wirral—not abundant. Chester. Holywell. Loggerheads. E.

Ennomos Tiliaria. Claughton and Clifton Parks, Birkenhead. Chester (*Day.*) E.

,, *fuscantaria.* Upton Valley; North Birkenhead—scarce.

,, *erosaria.* Tranmere. Rock Ferry (*Al.*) Scarce.

Himera pennaria. North Birkenhead and Eastham Wood (*Al.*) Puddington; Ness. Chester (*Day.*) E.

Phigalia pilosaria. Wirral, in most woods. Chester. Delamere. E.

Nyssia zonaria. Formerly abundant on Wallasey Sandhills; Hoylake Sandhills; Puddington Marsh. "Maintains "existence in a portion of the last locality which "is constantly covered by the tide. I have seen "the females crawling up rail posts to avoid the "tide." (*J.F.B.*) Rhyl Sandhills near Plas Tirion, formerly abundant, but not seen lately.

Amphidasis prodromaria. Eastham Wood (*Gallins.*) Whitford (*F.A.*) E.

,, *betularia.* Wirral. Black var. commonest in Eastham Wood (*W.G.*) Chester. Holywell. E.

Hemerophila abruptaria. Upton; Tranmere; Rock Ferry; Ness; scarce. Chester (*Manning.*) E.

Cleora lichenaria. Scarce at Frankby; Prenton Wood.

Boarmia repandata. Very common.

,, *rhomboidaria.* Not plentiful; Tranmere; Puddington; common at Ness. Lead Works, Chester. Holywell. Colwyn. E.

Tephrosia laricaria. E.

,, *punctulata.* E.

GEOMETRINA—*Continued.*

Gnophos obscurata. Wallasey; Bidston; Tranmere; Burton. Ysceifiog.
Pseudoterpna Cytisaria. Bidston Hill; Claughton Fir Wood. Haddon Wood, Ness. Loggerheads. E.
Geometra papilionaria. Scarce; Bidston; Rock Ferry; Ledsham. Holywell. Gresford (*F.A.*) Bathafarn. Ince (*N.*) E.
Iodis lactearia. Common.
Hemithea thymiaria. Wirral –not abundant. Chester. Holywell. E.
Ephyra punctaria. Scarce—Eastham Wood. E.
,, *trilinearia.* Wood nr. Holywell.
Hyria auroraria. E.
Asthena luteata. Scarce—Burton; Puddington. Holywell. E.
,, *candidata* Rather scarce; Wallasey; Bidston. Holywell.
,, *sylvata.* E.
Eupisteria heparata. Not very common; Rock Ferry. Puddington. Burton. E.
Aeidalia scutulata. Common
,, *bisetata.* Common.
,, *interjectaria.* "Not uncommon on the margin of the "sandhills near Wallasey village; common at Ness "and Burton" (*J.F.B.*)
,, *virgularia.* Not scarce on Bidston Hill and occasionally elsewhere. Lead Works, Chester. Tranmere (*W.G.*) (= incanata. *Hüb.*)
,, [*incanata.* (*Haw.*) = promutata (*Gn.*) Llandudno. Porritt in Ent. Vol. xiv. p. 216.]
,, *subsericeata.* Scarce—Bidston.
,, *remutata.* Wirral, most frequent in woods. Holywell, com.
,, *fumata.* E.
,, *imitaria.* Bidston; Ness. Chester, common. Holywell (*F.A.*) E.
,, *aversata.* Common.
,, *emarginata.* Rhyl, (*W.G.*)
Bradyepetes amataria. Not com.: Ness; Puddington. Chester. Ince (*N.*)
Cabera pusaria. Very common.
,, *exanthemaria.* Very common.
Corycia punctata. Eastham Wood (*Al.*) Chester (*Miss Smith.*) Colwyn. E.
Macaria liturata. Rather scarce, Prenton Mount Wood; Haddon Wood. Cwm Mountain. Woods nr. Llyn Helig. E.
Halia Wavaria. Wirral. Chester. Rhyl. E.
Strenia clathrata. Puddington. Llyn Helig. Delamere (*L.*) Colwyn
Lozozramma petraria. Bidston; Eastham Wood. Loggerheads. Colwyn. E.

GEOMETRINA—*Continued.*

Numeria pulveraria. Scarce, Claughton; Tranmere; Rock Ferry; Eastham Wood; Ness. Newton Lane, Chester. Holywell. Colwyn. E.

Mæsia Belgiaria. Scarce, Bidston Hill. Loggerheads.

Selidosema plumaria. Birkenhead (Stainton's Manual.)

Fidonia atomaria. Haddon Wood, Ness. Bagillt. Cwm Mountain (*F.A.*) Peckforton (*Day.*) Fawnog nr. Colwyn. E.

,, *Piniaria.* Fir woods of Bidston, Prenton, Stourton, Ness and Burton. Llyn Helig. Cwm Mtn. Delamere (*L.*) Loggerheads. E.

Aspilates sacraria. Scarce—Ness.

,, *citraria.* Delamere (*L.*)

Abraxas Grossulariata. Very common, but rarely a serious pest.

,, *Ulmata.* Generally distributed throughout the western part of the district, and not uncommon.

Ligdia adustata. Colwyn Bay, 1884.

Lomaspilis marginata. Common.

Hibernia rupicapraria. Wirral. Chester (*Day*). Delamere. E.

,, *leucophearia.* Prenton, Eastham, and Patrick (nr. Bromborough Mills) woods; scarce at Ness and Puddington. Delamere—com. E.

,, *aurantiaria.* Scarce. Denhall. Puddington. E.

,, *progemmaria.* Wirral. Chester. Delamere. E.

,, *defoliaria.* Rather scarce—Bidston; Upton; Birkenhead; Eastham Wood; Ledsham. E.

Anisopteryx æscularia. Wirral. Chester. Delamere. E.

Cheimatobia brumata. Very common.

Oporabia dilutata. Tranmere; Puddington. Chester. Holywell (*F.A.*) E.

,, *filigrammaria.* Bidston Hill (*Al.*) Loggerheads.

Larentia didymata. Common.

,, *multistrigaria.* Wallasey; Bidston; Burton. Colwyn. E

,, *cæsiata.* Moel Fammau. Cwm Mountain. Loggerheads.

,, *olivaria.* Bidston (*Al.*)

,, *miaria.* Common.

Emmelesia affinitata. Wirral. Holywell. Cwm Mountain. Llyn Helig. E.

,, *alchemillata.* Patrick Wood nr. Bromborough Mill (*Al.*) Puddington. Chester (?) Loggerheads. Colwyn. E.

,, *albulata.* Common.

,, *decolorata.* Wirral. Chester. Holywell. Loggerheads. Colwyn. E.

,, *unifasciata.* Scarce, Wallasey Sandhills (*N. Cooke.*)

Eupithecia venosata. Denhall—1 specimen. Hilbre Island, common on Silene maritima (*W.G.*) Colwyn—rather common.

,, *linariata.* Bidston; Tranmere. Colwyn.

,, *pulchellata.* Prenton Mount Wood; Rock Ferry; Ness; Burton. E.

GEOMETRINA—*Continued.*

Eupithecia centaureata. Wallasey; Bidston. E.
,, *succenturiata.* Wallasey; Tranmere; Puddington; Chester. E.
,, *subfulvata.* Wallasey; Burton. Holywell. Llyn Helig. E.
,, *pygmæata.* Dee Marsh nr. Puddington. Colwyn.
,, *satyrata.* Near Birkenhead; Burton. Llyn Helig.
,, *castigata.* Wirral. Cwm Mountain. Bathafarn. Colwyn.
,, *pimpinellata.* E.
,, *innotata* (*fraxinata J.F.B.*) Scarce; Rock Ferry; Puddington. E.
,, *indigata* Prenton Mount Wood; Ness; Burton. E.
,, *constrictata.* Near Birkenhead; Burton. Colwyn (?)
,, *nanata.* Bidston Hill; Claughton Fir Wood; Prenton Mount Wood. Moel Fammau. E. [Trefriw.]
,, *subnotata.* Scarce; Wallasey; Birkenhead; Denhall; Colwyn.
,, *vulgata.* Wirral. Chester. Holywell (?) E.
,, *absynthiata.* Wirral. Chester—com. E.
,, *minutata.* E.
,, *assimilata.* Wirral. E.
,, *tenuiata.* E.
,, *subciliata.* Colwyn (?)
,, *abbreviata.* Eastham Wood; Puddington. E.
,, *exiguata.* Puddington. E.
,, *pumilata.* Bidston Hill; Claughton Fir Wood; Haddon Wood.
,, *rectangulata.* Com. at Denhall; occasionally elsewhere in Wirral. Chester. E.
,, *lariciata.* E.
,, *Valerianata.* E.

Collix sparsata. E.

Lobophora hexapterata. Rather scarce; Ness; Puddington.
,, *lobulata.* E.

Thera variata. In most fir woods.
,, *firmaria.* Not abundant; Prenton Mount Wood; Haddon Wood; Ness; Puddington. E.

Ypsipetes ruberaria. Bidston Marsh. Holywell. E.
,, *impluviata.* In most woods in Wirral. Llyn Helig. Loggerheads. E.
,, *elutata.* Common.

Melanthia rubiginata. Rock Ferry; Ness; Puddington; Ledsham. Loggerheads. Ince (*N.*) Eaton, Chester '84. E. var. plumbata—scarce. Ledsham.
,, *ocellata.* Tranmere; Prenton Mount Wood; Burton. Loggerheads. Cwm Mtn. Llyn Helig. Talargoch (*F.A.*) Colwyn. E.
,, *albicillata.* Eaton Park, Chester.

Melanippe tristata. Loggerheads. [Trefriw.]
,, *unangulata.* Not com.: Flaybrick Hill; Ledsham; Tranmere; Puddington.

GEOMETRINA—*Continued.*

Melanippe rivata. Wirral (?) (*W.G.*) Loggerheads.
,, *biriviata.* Common.
,, *montanata.* Very abundant.
,, *Galiata.* Wallasey Sandhills; Ness; Burton. Loggerheads. Rhyl. E.
,, *fluctuata.* Very common.
Anticlea rubidata. Rock Ferry (?) (*W.G.*)
,, *badiata.* Wirral. Chester. Holywell. Loggerheads. E.
,, *derivata.* Rather scarce at Tranmere; com. Ledsham. Holywell. E.
Coremia propugnata. Wirral. Chester, common and apparently double brooded occurring again in mid-August. E.
,, *ferrugaria.* Birkenhead (*Al.*) Wallasey Sandhills; Puddington. [Trefriw.]
,, *unidentaria.* Wirral. Chester, very common and double brooded, the 2nd brood occurring at the end of July and beginning of August. E.
Camptogramma bilineata. Extremely abundant.
,, *gemmaria.* Birkenhead—rare; Burton—not uncommon. Warrington (Stainton's Manual.)
Phibalapteryx lignata. Bidston Marsh; Ness.
Scotosia dubitata. Occasionally in Wirral. Chester. Holywell. Colwyn. Cefn Caves (*W.G.*) E.
,, *undulata.* E.
Cidaria miata. Has been taken in North Birkenhead. E.
,, *picata.* Bathafarn nr. Ruthin.
,, *corylata.* Scarce—Puddington. E.
,, *russata.* Very common and variable.
,, *immanata.* Wirral. Holywell. E.
,, *suffumata.* Wirral. Chester. Colwyn. E.
,, *silaceata.* Colwyn. E.
,, *prunata.* Scarce. Burton. Holywell. Rhyl. E.
,, *testata.* Wirral. Cwm Mountain. Bagillt Marsh—com. Mostyn. Loggerheads. E.
,, *populata.* Wallasey Sandhills (*W.G.*) Holywell. Chester (?) Loggerheads. E.
,, *fulvata.* Common.
,, *pyraliata.* Common.
,, *dotata.* Puddington; Denhall. E.
Pelurga comitata. Wallasey; Denhall. Chester. Holywell.
Eubolia cervinata. Tranmere; formerly not uncommon in Clifton Park, Birkenhead.
,, *mensuraria.* Extremely abundant.
,, *plumbaria.* Common on heaths.
,, *lineolata.* Wallasey and Rhyl Sandhills.
Anaitis plagiata. Holywell. Loggerheads. Colwyn.
Chesias spartiata. Delamere (*L.*) Colwyn.
,, *obliquaria.* Delamere (*L.*)
Odezia chærophyllata. Bagillt.

PYRALIDINA.

Hypena proboscidalis. Extremely abundant.
Hypenodes costæstrigalis. Bidston Hill Fir Wood; Prenton Mt. Wood.
Schrankia turfosalis. Delamere (Stainton's Manual.) E.
Rivula sericealis. Not abundant. Ledsham. E.
Herminia tarsipennalis. Burton; Puddington; scarce. Holywell. E.
,, *nemoralis.* Eastham and other woods in Wirral. Chester. Holywell. E.
Pyralis farinalis. Common—bred by J.F.B. from moss from river bank near New Ferry.
Aglossa pinguinalis. Very common.
Pyrausta purpuralis. Wallasey Sandhills; Ledsham. Ysceifiog. Colwyn. E.
,, *ostrinalis.* Wallasey Sandhills. Colwyn. E.
Rhodaria sanguinalis. Wallasey Sandhills. Rhyl.
Herbula cespitalis. Wirral. Loggerheads. E.
Ennychia cingulalis. Wallasey Sandhills. Loggerheads. Talargoch. Bryn Eurin, Llandrillo. E.
Cataclysta lemnata. Common.
Paraponyx stratiotatæ. Bidston Marsh; Ness. Chester.
Hydrocampa nymphœata. Common.
,, *stagnata.* Less common than the last.
Botys verticalis. Chester—common on nettles.
,, *fuscalis.* Wirral. Bagillt. Loggerheads. E.
,, *terrealis.* Puddington—1 specimen. Loggerheads.
,, *urticata.* Common.
Ebulea sambucalis. Birkenhead. Chester (Miss Smith.) E.
Pionea forficalis. Common.
Spilodes sticticalis. Wallasey—scarce.
Scopula lutealis. Common.
,, *olivalis.* Common.
,, *prunalis.* Wirral. Loggerheads. E.
,, *ferrugalis.* Wallasey; Bidston; Rock Ferry: Ness. Loggerheads.
Stenopteryx hybridalis. Generally distributed.
Nola cucullatella. Wirral. Chester. E.
,, *cristulalis.* Puddington—scarce. Colwyn.
Simaethis Fabriciana. Wirral.
Eudorea cembræ. Scarce—1 specimen taken on ground now occupied by the Great Float, Birkenhead; another at Denhall.
,, *ambigualis.* Wirral. Chester. E.
,, *pyralella.* Ledsham; Puddington. E.
,, *truncicolella.* Wirral, on Scotch Firs. E.
,, *frequentella.* Bidston Hill; Ness; Puddington. E.
,, *murana.* Wirral, locality forgotten. E.
,, *angustea.* Wirral.

PYRALIDINA—*Continued.*

Eudorea mercurialis. E.
,, *pallida.* Bidston Marsh. E.
Aphomia colonella. Wallasey, occasionally; common at Burton, Puddington, and Ness. Colwyn.
Achroia grisella. Holywell.
Anerastia lotella. Wallasey Sandhills.
Ephestia elutella Wirral, about houses.
Homœosoma nimbella. Wallasey Sandhills.
Acrobasis consociella. Birkenhead, 1 specimen.
,, *tumidella.* Common in wood N. of Pen-y-maes, Holywell.
Cryptoblabes bistriga. Bidston Park Wood—scarce. Once near Birkenhead.
Myelois pinguis. Birkenhead (Stainton's Man.)
Pempelia fusca. Bidston Hill; Claughton Fir Wood. Llyn Helig. Moel Fammau. E.
,, *palumbella.* Bidston Hill; Haddon Wood; Ness; scarce. E.
Crambus falsellus. Ness. E.
,, *pratellus.* Common.
,, *dumetellus.* Wallasey Sandhills.
,, *hamellus.* E.
,, *pascuellus.* Bidston Marsh; Claughton Fir Wood; Ness; Burton. E.
,, *hortuellus.* Common.
,, *culmellus.* Common.
,, [*inquinatellus.* Llandudno—Porritt in Ent. xiv. 216.]
,, *geniculeus.* Wallasey Sandhills. Christleton. Colwyn.
,, *contaminellus.* Dee Marsh nr. Puddington; Denhall; rather scarce.
,, *tristellus.* Common.
,, *margaritellus.* Oakmere. E.
,, *pinetellus.* Colwyn. E.
,, *selasellus.* Dee Marsh nr. Puddington. E.
,, *latistrius.* Claughton Fir Wood; not uncommon.
,, *perlellus.* Marshes of Bidston, Bromborough and Puddington. Ince (*N.*) E.
Chilo forficellus. Bidston Marsh and Oxton—scarce; commoner at Little Neston and Burton. Chester by Canal—common. E.
,, *Phragmitellus.* Bidston Marsh—scarce (*Al.*)
Chloephora prasinana. Occasionally taken; Rock Ferry; Eastham Wood; Puddington. Delamere. E.

The Climate of the Chester District (including Denbighshire and Flintshire), considered in relation to Fruit Growing.

BY ALFRED O. WALKER, F.M.S.

Read before the Chester Society of Natural Science, April 7, 1881.

THE question has frequently been asked why we in England import so much fruit and grow comparatively so little, and the problem at first sight appears the more difficult from the fact that most of the countries which send us at all events our Apples and Pears, have a severer climate in winter than ours. I propose in this paper to consider one at least of the causes that lead to this result, and at the same time to compare the climate of those parts of England where orchards abound with those where they are comparatively rare. Let me, however, say at the outset that climate is probably not the only cause of one district or county producing more fruit than another. It is always difficult to say whether it is the love of cider that causes the natives of Herefordshire, Worcester, Somerset, and Devon to grow Apples, or whether it is the suitability of the soil or climate for growing Apples that has caused this to become the favourite drink. No doubt cause and effect re-act upon each other. Cider is brewed because Apples are abundant, and the increasing taste for cider causes more Apples to be grown. At the same time a good deal must be allowed for that unaccountable thing "custom" or "fashion." On the whole, however, I incline to the belief that it is the suitability of the climate that has originally caused the trees to be grown, inasmuch as the natives are of the same stock as we are, and there is no reason to believe that cider was drunk in very ancient times; * while as regards soil there are very great differences in the geological formations of the above-named counties (which with Middlesex are, as will be seen from the table, the five great orchard counties), and there is undoubtedly abundance of good soil in almost all English counties suitable for orchards. Possibly the system of land tenure may have something to do with the question, as orchard trees are many years before they become profitable, and are therefore likely to be planted only by free-

* Although the counties where cider is drunk remained Celtic long after the occupation of the eastern side of the island by Teutonic races, yet there is no Welsh word for cider. As it is largely made in Normandy, it was probably introduced by the Normans.

holders. Still I am not aware that there are more small freeholders in the above-named counties than elsewhere, or that there is anything except the greater suitability of the district for fruit growing that should incline landlords to plant fruit trees more there than elsewhere. It might be thought that more fruit would be grown where the population is densest, but Table I. shows that Hereford, where there are most orchards, has almost the smallest population in proportion to cultivated land, while Middlesex, the third largest fruit grower, has the largest population.

In Table I., compiled from the last Blue Book, showing the proportion of orchard land to the rest of the cultivated land (including permanent pasture, but not mountain or heath land), it will be seen at once that, with the exception of Middlesex and Kent, both of which have an artificial stimulant to the production of fruit in the close proximity of the great consumer, London, the principal orchard counties are grouped round the Bristol Channel. From the Table of Temperatures (Table II.), it will be seen that Liverpool—*i.e.*, Bidston Observatory, on this side the Mersey, which may be taken as fairly typical of our district, with the exception of the more mountainous parts of Flint and Denbigh and the interior of Cheshire—shows on an average of three years a very high mean minimum temperature in April, and a low mean maximum temperature in August. Compared with Cheltenham, which is the most central station for the cider counties of which continuous records are obtainable, we have the following results :—

	Mean Min. in April.	Mean of Lowest in April—Three Years.	Mean Max. in August.
Liverpool	40°.4	33°.1	66°.4
Cheltenham	37°.8	25°.5	69°.1
Difference	2°.6	7°.6	2°.9

From the above we see that while the mean minimum temperature at Liverpool in April is 2°.6 higher than that of Cheltenham, the mean maximum temperature in July is 4°, and August 2°.9 lower at Liverpool than at Cheltenham. And if we take the average of the lowest temperatures recorded in April for three years at each place, we find that the difference is much greater, Liverpool being 7°.6 higher than Cheltenham.*

* This is important, as a single night's severe frost when fruit trees are in full blossom would be fatal to a good crop. It may be mentioned here that the temperatures are taken from the *Quarterly Journal of the Meteorological Society*, except Chester, which are from my own observations, with verified instruments in a Stevenson case. To illustrate the value of a difference of a very few degrees of temperature, the difference between mean maxima of the miserable August of 1879, and the unusually fine and hot August of 1880 was only 4°.7 at Liverpool.

TABLE I.

County.	No. of Acres per Head of Population.	Proportion of Orchards to 100 Acres of Cultivated Land.
Hereford	4.2	6
Worcester	1.4	4
Middlesex	0.07	2.8
Somerset	2.2	2.7
Devon	2.7	2.24
Gloucester	1.5	2.17
Kent	1.2	2
Monmouth	1.9	1.5
Cornwall	2.4	0.85
Dorset	3.2	0.76
Surrey	0.4	0.59
Notts	1.6	0.38
Wilts	3.3	0.37
Cambridge	2.8	0.33
Cheshire	1.2	0.32
Lancashire	0.4	0.31
Sussex	2.2	0.29
Warwick	0.9	0.24
Lincoln	4	0.10
Denbigh	3.7	0.07
Cumberland	4.4	0.05

There is a very widespread belief that the principal factor in determining the crop of tree fruit—viz., Pears, Apples. Cherries, and Plums, with which alone I am at present concerned, is the amount of frost in spring when the trees are in blossom. If this were the case, then the west coasts of England, Wales, Scotland, and, still more, of Ireland, would be the most favourable climate, not only in our own islands, but of all Europe, north of, say, the 45th parallel of latitude, for growing fruit, and North America, except the Southern States, would not have a chance against us with their rigorous winters. Yet as a matter of fact we find that precisely those countries that have the coldest winters are the greatest producers of the above tree fruits, and that those, like our own west coasts, that have a mild and equable climate, produce the least. This clearly points to some other cause than the above as determining the suitability of any given area for the production of fruit, and there can be little doubt that this will be found to be the summer temperature, and that the higher this is the better for this purpose. And inasmuch as a country having a dry atmosphere, which offers less resistance to the radiation of heat from the sun to the earth on the one hand, and from the earth into space on the other, than a moist one, will have at once hotter summers and colder winters than a moist country, it follows that the further we go from the breezes which reach our western coasts laden with moisture from their long sweep over the Atlantic, the more profitable will it be found to plant fruit trees, other conditions of course being equal; hence it comes that we find ourselves supplied with Apples from America and Pears from the interior of France, in both of which countries the heat in summer and the cold in winter are much greater than in this country.

TABLE II.

		Barnstaple. Devon.	Brighton. Sussex.	Cheltenham Gloucestershire.	Cambridge.	Liverpool.	Truro.	Chester.
		°	°	°	°	°	°	°
Average Mean Minimum Temperature, 1878 to 1880	April.	42.8	40.4	37.8	38.1	40.4	41.3	38.5
	May.	47.9	44.9	41.7	45 4	45.2	..	..
	June.	54.0	51.5	49.0	49.3	51.4	..	..
Lowest Temperature in April..	1878	35.0	28.2	22.4	23.6	32.5	28.0	..
	1879	27.0	26.5	26.5	28.0	29.8	24.0	..
	1880	36.0	36.4	27.5	30.0	36.9	31.0	..
Average	..	33.0	30.4	25.5	27.2	33.1	27.7	..
Average Mean Maximum Temperature, 1878 to 1880	July.	70.9	70.2	68.4	72.0	64.4	68.9	68.2
	Aug.	72.2	70.0	69.1	73.2	66.4	69 9	69.4
	Sept.	66.8	65.6	64.1	68.3	62.2	65.8	64.9

		1878.	1879.	1880.		Liverpool.	Colwyn.
		°	°	°		°	°
Mean Maximum at Liverpool..	July.	67.3	61.6	64.4	Mean Minimum in April, 1880	41.5	41.0
	Aug.	67.2	63.6	68.3			
Mean Maximum at Colwyn....	July.	..	..	65.9			
	Aug.	..	..	69.2			

The summer temperature acts on the fruit crop in a twofold manner, affecting both the quantity and the quality: the first by the extent to which it ripens the wood of the trees, and the second by the more or less perfect ripening of the fruit. This has been well exemplified in the last two years in my own garden at Colwyn Bay. The summer of 1878 being a fairly hot one, and the wood of the trees well ripened, pyramid Pear trees bore remarkably well in the summer of 1879, but this last being extraordinarily wet and cold the fruit barely ripened, and was very inferior in quality; and in consequence of this weather not ripening the wood in 1879 the crop in 1880 was simply *nil*. It is worth while remarking that the hot month in 1878 was July (mean maximum at Liverpool, 67°.3, in August, 67°.2), and that the Pears bore abundantly, requiring much thinning, while Apples bore but indifferently; and as there was no frost there when the trees were in blossom, which was three weeks later than in the previous year (Pears only beginning to open their blossoms on April 29), this difference in production can only be accounted for by the fact that Pears make their growth earlier than Apples, and are consequently more favourably affected by an early heat Last summer (1880) both August and September were hot months, the highest temperature being on September 4 or 5, and we have consequently every reason to expect a fine crop of both Apples and Pears.

To return to the question of the climate of different parts of England, it will be seen from Table II. that the highest mean maximum temperature is at Cambridge, and the question arises why more fruit is not grown in what may be called the south-central and south-eastern parts of England, where no doubt the summer temperature is highest? The only answer I can suggest to this is that these counties are for the most part flat, and that, according to my friend, Mr. W. H. Ashwin, who lives in the Vale of Evesham, one of the largest fruit-growing districts in the kingdom, orchards are found to answer best when planted on the slope of a hill. This is due partly to the temperature being lower, on a dead level, or at the foot of a hill, than on a slope, from the tendency of the denser cold air to fall to the lowest level, and partly, I venture to think, to the shelter from wind afforded in an undulating as compared with a flat country, inasmuch as it is obviously fatal to profitable fruit-growing on large standard trees if they are constantly liable to have the fruit blown off before it is ripe. And though the mean minimum temperature in April on an average of the last three years is shown in Table II. as slightly higher than that at Cheltenham, yet there is no doubt that, as a rule, the central counties are subject to severe frosts in spring, and this, though of less importance than summer temperature, does yet at times seriously affect the fruit crop.

With reference to the practical question of the best kind of fruit to grow to a profit in our district, and the best mode of growing it, a few words will suffice. The treatment of tree fruits may be summed up in two or three words—give them all the sun you can. This is best attained by growing them against walls in the case of the more tender, and on espaliers in the case of the hardier kinds. Grapes may be grown, and will no doubt ripen after a fashion, against a south wall; but I have no experience of them, and can only say that I doubt whether they would ever be worth the space they would occupy. I would only say in passing, that the locality which was lately chosen for an experimental vineyard—viz., near the coast of South Wales—was one of the worst that could have been selected The centre of Yorkshire would probably have been better! The only part of England where such an experiment is likely to succeed is in the south, south-east, or south-central districts, and even there I fear the result would only be the production of what the Germans call "three-man wine," *i.e.*, wine that it requires three men to take one to sit on a chair, another to hold him fast there, and a third to pour the wine down the throat of the first! The greater part of the countries where wine is made (*e.g.*, the interior of France, Germany, Hungary, &c.) are subject to great extremes of heat and cold, or at any rate to great heat in summer.

Peaches, Nectarines, and Apricots, which are always grown on the warmest walls, blossom very early, and unless protected are very liable to have the bloom destroyed by frost. From the mode of training they have a better chance of ripening their wood than trees not so grown, and near the coast they have a better chance of escaping frost than they have inland. My experience of these fruits at Colwyn Bay is, that they much oftener bear good crops (without any protection) than do bush and pyramid Pears and Apples. The fruit, however, is small, poor in flavour, and addicted to mildew in the case of Peaches.

Plums require to be grown on warm walls, or they rarely bear at all. Cherries also, except some of the hardiest kinds, do little good as pyramids, and though the choicer sorts often bear freely yet they do not ripen their fruit. There is a fatal objection to growing this fruit on large standard trees, that unless the number of trees be enough to make it worth while to keep a "tenter" to look after them from daybreak to dusk, the birds will eat the fruit before it is ripe. On a wall they can be protected with nets.

Apples and Pears should be grown on espaliers, which are best made of galvanised wire with iron supports. By this means every shoot gets thoroughly exposed to the sun, and the growth is more easily kept in check. The value of pyramid and bush trees may be judged of by the fact, that in 1868 I planted a considerable number of various kinds of Pears in my garden at Colwyn, which has a dry warm soil and a warm aspect, yet I never had anything like a crop except in the summer of 1879, as already mentioned. There are, however, two varieties of Pears which are honourable exceptions—the one a little known kind called Beurré Goubault, which ripens in September or October, and requires to be eaten at once, and the other, what I believe to be Louise Bonne, though it was sold to me as Beurré Hardy—a delicious Pear, but not a late keeper. On the other hand, Pears on a south-east wall of all kinds that I have tried bear well. I have not sufficient experience of them on espaliers.

Much the same may be said of Apples, though some varieties of these will bear in almost any situation, and others in no situation. Among the former may be named Lord Suffield, which would be the finest kitchen Apple ever grown if it only kept longer, and among the latter an American variety called Northern Spy, which has not borne a single fruit in twelve years though trained on a south-east wall. But as the soil has no doubt much effect on different varieties this is not the place to enumerate those that bear well. I will only say that most kinds bear well when trained on espaliers, and that scarcely any can be relied upon to bear a crop even in a favourable situation when not so trained. And some idea of the utter futility of planting fruit trees in an unfavourable situation may be formed from the fact that in 1870 I planted an orchard of Apple, Pear, Plum, and Cherry trees (standards and pyramids) at the bottom of the slope on which the garden lies and where the ground is somewhat shaded by trees, though not to the south-west, and during the whole ten years I can safely say that I have not had a total of three bushels of fruit of all kinds! There was probably six times as much as this from the pyramid Pear trees in the higher part of the garden in 1879, though the fruit was heavily thinned. And this deficiency was not due to the destruction of the blossom by frost, as might be supposed from its lying low, because there has never been much blossom to be destroyed; which leads me to the further remark that in the spring following a cold summer, a considerable amount of blossom may be seen, which, however, leads to no corresponding quantity of fruit, and such fruit as there is is generally poor and small. This is without reference to the frost in April, 1880; there was a considerable amount of blossom both on Apple and Pear trees at Colwyn Bay, and the lowest temperature during the month was 32°.2, yet there was scarcely any fruit, which, in my opinion, was solely due to the inability of the imperfectly ripened wood to bear fruit.

Of the small fruits, by which I mean Strawberries, Raspberries, Gooseberries, and Currants, I need say little. Being natives of this country, or of countries having a similar climate or inhabiting woods, they do not require so much sun, and are consequently dependent probably on soil rather than climate for profitable cultivation.

In conclusion, it seems doubtful whether, with the present facilities of communication and carriage between one country and another, it will pay to grow the hardier and less perishable fruits, such as Apples and Pears, except as a luxury for the rich. And the more perishable labour under the disadvantage that they require to be consumed immediately, so that the market is glutted when they come in. At the same time the small fruits require so little attention, come so soon into bearing and are generally so certain in cropping, that (especially in the neighbourhood of large towns) they are probably much more profitable to grow in this district than what I have called tree fruit.

[The present year, 1885, is strongly confirmatory of the above views. The summer of 1884 was a remarkably hot one, and the promise of tree fruit is now (May 30) very great.]

Surface Dredging on the Dee.

BY DR. H. STOLTERFOTH, M.A.

Abstract of Paper read on 16th January, 1879.

I HAVE worked during the past year with a view to ascertaining what are the special forms of Microscopic life found on the surface of the Estuary of the Dee. My method of obtaining these organisms is as follows :—

As the mass of water is greatly in excess of the minute forms to be collected, the object must be to concentrate them, and for this purpose the simplest form of dredge is a hoop about a foot in diameter with a canvass bag attached. This is dragged after the boat, and when taken in must be turned inside out and washed in a wide-mouth jar until all that clings to the canvass be removed ; this must settle down, and then be stored away in small bottles to be taken home and examined at leisure. The forms, however, that are obtained are so very minute, that I had an idea that many of them must escape, even through a canvass bag ; I therefore devised a glass bottle to be tied to the end of the bag, and as it was desirable that the water should be constantly changed, I introduced a funnel and a syphon, which answers the purpose for which it was intended, and gives the small bodies that enter the bottle time to settle down. Both these forms of dredge I have used during the past summer on the Dee.

On June the 12th, 1878, I dredged with some of the Liverpool Field Club off Hilbre Island. The sun fortunately came out to tempt the animalcules to the surface, and I got a good supply of a brown yellowish sort of floculent matter ; this I put in bottles to be examined under the microscope at home. As long as your collection is fresh, the greatest interest is the study of the living forms, but as with such delicate organisms (many of them injured by the mere collecting) this pleasure cannot last for long, it is well to know some means of preserving them. One plan is to add a little Carbolic acid directly to the sea-water ; the bottle will then keep without any disagreeable smell for months. My plan, however, is generally to wash in fresh water until all trace of salt is gone. This I do by turning the bottle into a test tube; I then fill up with fresh water—shake—let the forms settle, pour off the water, and repeat the process till all salt is gone; then drop a portion on a thin glass cover, which, placed on a platinum sheet, can be burnt over a spirit lamp. This removes all the carbonaceous matter—but do not press the burning too much, or you may fuse even silicious forms. By this process you get filamentous forms of the Diatomaceæ in their natural position, which is very interesting.

I will now describe what I found in this dredging:—

Noctiluca Miliaris. There were a few of these animals, but on other occasions in the same locality I have found them more abundant.

The rest of the collection was made up entirely of Diatoms.

1. *Eucampia Zodiacus*, W. Sm. Abundant, and in good preservation. I noticed amongst the *Eucampia* another form which I took to be *Britannicus*, W. Sm. This has the appearance of *Zodiacus*, but wants the semicircular holes which mark that species.

2. *Biddulphia Baileyii*, W. Sm. Very abundant. This form grows in filaments, but is very easily broken up.

3. *Asterionella Bleakleyi*, W. Sm. Abundant. This form always abundant in the early part of the summer.

4. *Creswellia turris*, Grev. Several specimens. This form is new in the Estuary of the Dee, and has been seen by few observers as a British species. The genus was established by DR. GREVILLE. This diatom was found by DR. WALKER ARNOTT in the Clyde, but had previously been observed by the REV. R. CRESSWELL, when at Teignmouth, in the stomach of *Cynthia rustica*. The frustules are united by means of a circle of numerous short terminal processes of equal length. In the Dee dredgings I have found as many as seven valves of this species connected together. In a slide given me by MR. HARDMAN from Hong Kong Harbour, I have found several varieties of the *Creswellia*—one identical with the Dee specimen, the only difference being that those from Hong Kong have the silicious covering more fully developed, owing probably to their growing under more favourable circumstances. This new genus, *Creswellia*, does away with a large number of different genera established by Ehrenberg and Kutzing from fossil Diatomaceous earths, *Dictyopyxis*, *Stephanopyxis*, *Xanthopyxis*, &c., &c.

5 *Triceratium Brightwellii*, Bright. Rare. This curious form is remarkable for the great length of the connecting zone, which is only very slightly silicious. On account of the exceedingly long process at the extremity it would appear that this species is nearly connected with *Rhizosolenia*.

6. *Actionoptychus undulatus*, Ehr. Rare. A widely distributed species, and abundant in many fossil deposits.

7. *Coscinodiscus radiatus*, Ehr. Rare. This is also a widely distributed species, and the finest specimens are obtained from the open sea in all parts of the world.

8. *Rhizosolenia styliformis*, Brightw., is a beautifully marked diatom. Very abundant.

9. *Chaetoceros Wighamii*, Brightw. Rare. This form, although growing in filaments, is so easily broken that I have never seen more than two or three valves together.

10. *Melosira sulcata* (Ehr.), Kütz. Rare. This form makes up the bulk of many of the American fossil deposits.

11. *Eucampia striata*, n. sp. Described and figured by me in a Paper read before the Royal Microscopical Society (Oct. 8th, 1879.)

On July 12th I had another day's dredging off Hilbre Island, which was also rich in all the smaller forms. I examined this dredging in the fresh state, and found in it the only living Foraminifera that I have met with on the surface of the Dee, *Textularia variabilis*. The absence of living Foraminifera from the surface of the Dee is a very significant fact, showing at least that the estuarine forms frequent the lower water, for the most part living among the weeds which cover the bottom. The next living form which particularly engaged my attention was the genus of Infusoria called *Peridinium*. I was led to look for this form, and able to recognise it, from the fact that it had much puzzled me when I first saw the skeleton on a piece of talc sent me by Count Castracane from the Adriatic, where these organisms attain a very large size, and the long sweeping horns present a marked appearance. The species was *Macroceros*. On looking over a surface dredging I have from Yeddo Harbour, I find I have *P. (Ceratium) Michaelis*, which has the horns very short. It is said that in warm latitudes these Infusoria are brilliantly phosphorescent. The lorica is described as membranous. It appears to me to be chitinous, and will withstand a moderate amount of fire and acid. In observing the forms obtained from the Dee, I could easily make out the band of cilia round the body, which was placed in an oblique direction, so that the animal had a rolling sort of motion such as you see in detached Stentors. The horns seem to have no motion, and I had difficulty in making out the flagellum. I am strongly inclined to believe that many of the species described by Pritchard are only different stages of growth. Perty, who is one of the authorities on this genus, has accepted the division of Ehrenberg, viz.—those with horns, and those without, and in this I agree. It is said that *Peridinia* exist in the chalk beds of the secondary strata; if so, they are amongst the few ciliated Infusoria that have left a geological record.

The forms I found in the Dee were—

Peridinium (Ceratium) tripos.

„ „ *fusus.*

The rarer forms of Diatoms found in this dredging and not mentioned in the previous list are—

Biddulphia aurita, Breb. Rare. This form I have never found abundant in the Dee.

„ *radiata*, Roper. This is a curious variety, easily overlooked, and might be mistaken for a *Coscinodiscus.*

Triceratium favus, Ehr. Rare.

„ *alternans*, Bailey. Rare.

Eupodiscus Ralfsii, W. Sm. Common.

Actinoptychus splendens, Ralf. This is a beautiful form and I never met with it in the same abundance.

Toxonidia Gregoriana, Donkin }
„ *insignis*, Donkin } These two forms are often found on the tidal mud.

Pleurosigma Normanii, Norman.

Melosira Westii, W. Sm. Rare.

Podosira maculata, W. Sm. Rare. This form is attached when in the growing state.

Nitzschia virgata, Roper. Rare.

Bacillaria paradoxa, Gmelin, rare.

Doryphora amphiceros, Kütz. Common. There are several different forms of this species.

Navicula lyra, Ehr. Rare.

„ *aspera*, Ehr. Rare.

Amphiprora maxima, Greg. Rare.

Dictyocha gracilis. Common. This is a doubtful Diatom and may be a Radiolarian; if so, it is the only one I have found in the Dee.

On August 24th, I had a surface dredging in the Estuary as far as the Point of Ayr. All the forms were Diatomaceous.

Coscinodiscus concinnus, W. Sm. Common. This is a very large form, very delicate and thin, and exceedingly convex, so much so that the whole form can never be got into focus at once. MR. HARDMAN tells me that this form is doubtfully *concinnus.* It is almost always found associated with *Bacteriastrum.*

Coscinodiscus eccentricus, Ehr. Common.

Bacteriastrum varians, Lauder. Abundant. This form has received many names, and been made into many species. If this form had been found only in the disintegrated state, the separate valves might have been thought to be different species, but on examining them when joined together, as I was able to do in this gathering, I found all the named varieties on the same filament. In the interior of the valves there are some curious hispid bodies which are often seen in fossil Diatomaceous earths. These may be sporangial.

Chœtoceros boreale, Bailey. Abundant. This is a delicate filamentous form which varies considerably, and presents different appearances at different stages of growth.

Nitzschia panduriformis, Greg. Rare. A small variety.

Pleurosigma acuminatum, W. Sm. This is a salt-water variety resembling *attenuatum*.

These are some of the most remarkable forms found in three different surface dredgings The words " rare," " common," " abundant," apply only to each particular gathering. These three dredgings show how rich the Estuary of the Dee is in minute forms of life.

Note on Glauconome disticha, from the Bala Beds of Glyn Ceiriog.

BY GEORGE W. SHRUBSOLE.

Read February 1st, 1883.

AMONG the many interesting forms of life in the Bala beds, which stretch across the valley of Glyn Ceiriog, few exceed in interest the Polyzoan, hitherto known as *Glauconome disticha*, in whatever light we regard it, whether as the earliest member of a large and important family, or as the representative of a class which now for the first time, so far as is yet known, makes its appearance, and at the onset presents a robustness of character and a development which are not surpassed by any allied species, during even the Carboniferous epoch.

It is nowhere a common fossil. Even in Glyn Ceiriog, where it is perhaps most abundant, a day's hunting may sometimes not yield a single example. In a quarry by the roadside, on Cefn-coch, at the back of Glyn Ceiriog, I have found it occurring freely, in common with other Polyzoans.

The appearance of the fossil is striking. It consists of a series of straight stems, springing from a common base, and intimately bound together by secondary branches, from which spring cross-bars, which coalesce with similar bars from the opposite branch. The connection of these several leading branches forms the whole into a fine frondose expansion. One face only of the cœnæcium is covered with a double row of circular cell-openings leading to the home of the polypide, which consists of a long tapering cylindrical cell, and these cells are arranged one over the other in the substance of the branch.

While the appearance of the fossil on the newly-broken surface is striking, the minute details of its structure are often obscure, for the whole of the calcareous part of the Polyzoan has been removed, and an ochreous deposit has taken its place. In one of my visits to the Glyn, I was fortunate in finding an example, in which the deposit had taken the form and shape of the cell. This gave me the means of verifying the correctness of the reference of this species to *Glauconome.* I had long had my doubts on the subject. When attention was first called to it by MURCHISON, McCOY was himself in doubt whether it could correctly be referred to the Dudley *Glauconome*, but ends his doubts by saying that it was "impossible to separate them specifically." Still later MR. ETHERIDGE, Junr., proposed to assign this Bala species to *Ramipora*, a genus founded by TOULA upon a fragment of a Polyzoan brought from the Arctic regions. The reference mainly rested on a certain outward resemblance, not very reliable or marked, for while the Bala species has only two rows of cells on the branch, *Ramipora* has five or six.

The type species from the Dudley Limestone is thus described by LONSDALE—"Stem strong, thin, elongated, oval, branched, cells disposed longitudinally, and alternately, in rows over one half of the surface, the other half striated longitudinally. Nature of the covering and opening of the cells unknown."

I may supplement the above by stating that, after careful examination, I find the cell open and exposed throughout its entire length; this is not accidental, but characteristic. The cells are built up of a series of thick longitudinal walls running parallel with the branch, and divided at regular intervals by cross walls, which go to form the cell, or rather cell area, which is depressed in the centre, and may be pyriform or quadrangular in shape The keel is normally rounded, having on the elevated portions prominent nodes.

The most remarkable feature about the cell is its open character, for out of the many examples I have examined I have not found one otherwise. That this is not due to the wearing away of any part of the structure is apparent from the fact, that even more delicate Polyzoans associated with it are not affected. LONSDALE noticed the same peculiarity; for he says that "the nature of the covering and opening of the cells is unknown." This is still the extent of our knowledge.

We turn now to the *Glauconome* from the Bala beds, and at once we notice the structural contrast. Here we have a long tapering cylindrical zoœcia, buried in the substance of the branch, as against an open quadrate cell. Any relationship between two species of Polyzoa, with this diverse character, is out of the question. The difference is even more than generic. They cannot be classed in the same sub-order, for while the cylindrical form of cell and its arrangement in the Bala species indicate its Cyclostomatous character, the zoarial features in the Dudley species point to a more primitive arrangement of the cell, unlike anything seen in recent types of Polyzoa. It cannot belong to the Cyclostomata, or to any of the existing sub-orders, which have been constructed for the reception of recent types. For the reception of it and similar Palæozoic species, MR. VINE proposes a new sub-order—Cryptostomata.

The effect of this discovery of the diversity between these species will be, so far as the nomenclature is concerned, as follows;—

1. That the type species of *Glauconome disticha* from the Wenlock limestone will be (so far as known at present) the sole representative of the genus;

2. That the Devonian and Carboniferous *Glauconome* will form a new genus, for which the name *Pinnatopora* is suggested;
3. That the genus *Pinnatopora* will also include the species from the Bala beds, hitherto referred to *Glauconome*.

The new genus to include the discarded *Glauconome* will be as follows—

PINNATOPORA. Nov. Gen.

GLAUCONOME (pars.) McCoy, Brit. Pal. Fos. p. 49.

Zoarium made up of a series of main stems, having a common attachment, with secondary and tertiary branches, given off at an acute angle. The tertiary branch may or may not unite with a corresponding branch on the adjoining stem. Zoœcia cylindrical, arranged in longitudinal and alternate series over one half of the surface. Between the row of cells a dividing keel.

PINNATOPORA SEDGWICKII. Shrubsole.

Glauconome disticha (pars.) Lonsdale, Brit. Pal. Fos. p. 49.
Ramipora Hochstetteri, var. carinata, R. ETH., Jun., Geol. Mag. 1879, p. 241.

Sp. char.—Zoarium a series of main, non-bifurcating stems growing from a common base, having alternate, secondary, and tertiary branches, the latter uniting with a corresponding branch on the adjoining stem, so as to connect the entire zoarium. Zoœcia long, tubular, aperture circular, arranged longitudinally in alternate rows spread over one-half of the surface. A dividing keel between the rows of cells. Reverse angular.

Obs.—The chief interest of this species is that it is the oldest known representative of its class. It is the head of an important genus ranging from the Bala or Caradoc beds to the latest Carboniferous. Although the earliest of its kind, this species was of strong robust growth, exceeding in size the species of later date. Large fragments of it are frequently found in the Bala beds, far less broken than any of the Carboniferous species. That so fragile an organism should be found in an almost unbroken condition suggests the explanation that the sediment, from whatever cause, must have accumulated very rapidly around it.

An excellent drawing of it will be found in the Geological Magazine, for June, 1879.

Locality.—Fairly abundant in the Bala beds of Glyn Ceiriog, Denbighshire, and Bwlch-y-gaseg and Cerig Coedog, South of Corwen, and Bryntirion, West of Corwen.

A List of the Land & Freshwater Shells of the District.

COMPILED BY GEORGE W. SHRUBSOLE

THE present is the second occasion on which the shells of this district have been tabulated. About thirty years ago there existed in Chester a Natural History Society, of which W. J. BELLARS was the Secretary. The best work done by this Society was the collection of local shells In 1858, BELLARS published an Illustrated Catalogue of British Land and Freshwater Shells, in which he describes and figures in all 125 species.

At the present time twenty names on BELLARS' list would be regarded either as varieties only, or as doubtful British species. They are as follows:—

DOUBTFUL BRITISH SPECIES.	VARIETIES.
Helix aperta	Cyclas pulchella is Pisidum fontinale, var.
,, depilata	,, Henslowania is ,, ,, ,,
,, rufescens	,, pusilla is ,, nitidum ,,
,, fulva	,, pisidiodes is Sphærium corneum ,,
Bulimus decollatus	,, cinerea is ,, rivicola ,,
,, Goodallii	Limnæa acuta is Limnæa peregra ,,
Clausilia papillaris	,, Burneti is ,, ,, ,,
	,, fragilis is ,, stagnalis ,,
	Unio ovalis is Unio tumidus ,,
	Limax brunneus is Limax agrestis ,,
	Clausilia dubia is Clausilia rugosa ,,
	Cyclas pusilla var.
	Unio pictorum var.

BELLARS in his list gives the localities around Chester, in which he found, according to our present reading, 61 species. The supposed finding of *Limnæa auricularis* by BELLARS is clearly an error; for not only have we failed to find it at the locality mentioned, but the figure and descriptive account are both faulty. In the latter it is said to be only one-sixth wider, instead of double the width of *Limnæa peregra*.

The present list contains the names of 93 species and 19 varieties of Land and Freshwater Shells found in our district.

The following list has been compiled from local collections, which have been sent in from time to time at the Annual Conversaziones.

The initials occurring after the locality indicate the name of the collector, thus—(H.G.B.) Rev. H. G. BARNACLE, Holmes

Chapel; (A.O.W.) ALFRED O. WALKER; (E.H.A.) E. H. ACTON, Wrexham; (R.W.) RICHARD WILSON, Wrexham; and (G.S.) GEORGE SHRUBSOLE, Chester.

A star is placed against each species which is recorded in BELLARS' list as found by him in this district.

The present list must not be regarded as exhaustive, since there are several common species not recorded, which have evidently been overlooked.

Aquatic Shells found in the District.

ORDER LAMELLIBRANCHIATA.

Name.	Occurrence.	Locality.
SPHÆRIIDÆ.		
Sphærium corneum, *Linné* *	Abundant	Canal between Mollington and Christleton (G.S.)
,, ,, var. nucleus	Local ...	Queen's Park (R.W.)
,, lacustre, *Müller* ....*	Local	Upton (R.W.)
,, rivicola, *Leach* ......*	Common ..	Canal near Chester (G.S.)
,, ovale, *Férussac*	Rare	Canal nr Stonebridge (R.W.)
Pisidium amnicum, *Müller* *	Common ..	Canal (G.S.)
,, fontinale, *Draparnaud**	Common ..	Canal (G.S.)
,, pusillum, *Gmelin* ....*	Local	Canal (R.W.)
,, nitidum, *Jenyns*	Rare	Curzon Park (R.W.)
,, roseum, *Scholtz*	Rare	Blacon Point (R.W.)
UNIONIDÆ.		
Unio tumidus, *Phillippsson* *	Common ..	Canal between Mollington and Chester (G.S.)
,, pictorum, *Linné* ....*	Common ..	Canal (G.S.)
,, margaritifer, *Linné* .	Local	River Dee (E.H.A.)
Anodonta anatina, *Linné* ..*	Common ..	Serpentine in Curzon Park (R.W), Canal near Mollington (G.S.)
,, cygnea, *Linné*........	Local	Kinnerton (G.S.), Curzon Park (R.W.)
DREISSENIDÆ.		
Dreissena polymorpha, *Pallas* *	Abundant	Canal round Chester (G.S.)

ORDER PECTINIBRANCHIATA.

Name.	Occurrence.	Locality.
PALUDINIDÆ.		
Paludina vivipara ....*	Abundant	Canal round Chester (G.S.)
Bythinia tentaculata, *Linné* *	Common ..	Canal, Mollington Marshes, and Meadows, Queen's Park (G.S.)
,, ,, var. decollata	Scarce	Rowton Canal B'ge (H.G.B)
,, Leachii, *Sheppard* ..*	Scarce	Blacon Point, (G.S), Queen's Park Meadows (R.W.)
VALVATIDÆ.		
Valvata piscinalis, *Müller*..*	Common ..	Queen's Park Meadows, Canal (G.S.)
,, cristata ,, ..*	Scarce	Ditches, Lache Lane (R.W.)

ORDER PULMONOBRANCHIATA.

Name.	Occurrence.	Locality.
LIMNÆIDÆ.		
Planorbis carinatus, *Müller* *	Local	Mollington Meadows (R.W)
,, complanatus, *Linné* ..	Common ..	Mollington Meadows (G.S.)
,, ,, var. albida	Local	Blacon Stream (R.W.)
,, vortex, *Linné* ......*	Common ..	Curzon Park (G.S.)
,, ,, var. compressa	Local	Mollington Meadows (R.W)
,, contortus, *Linné* ....*	Local	Canal; Mollington Meadows (G.S.)
,, albus, *Müller* ......*	Local	Pool at Christleton (G.S.), Upton (R.W.)
,, nitidus ,, ...*	Rare......	Ponds in Queen's Park (R.W)
,, nautileus, *Linné* ....*	Local	Mollington Meadows (R.W)
,, spirorbis, *Müller* ....*	Local	Queen's Park (G.S.)
,, nautileus var. cristata..	Local	Mollington Meadows (R.W)
Physa hypnorum, *Müller* ..*	Local	Ditches in Lache Lane (G.S)
,, fontinalis ,, ...*	Common ..	Pits around Upton (G.S.)
Limnæa peregra ,, ...*	Everywhere	Ponds and ditches around Chester.
,, stagnalis, *Linné* ....*	Common ..	Serpentine in Curzon Park (G.S)., Waverton Pits (G.S.)
,, ,, var. fragilis ..	Local	Wrexham Road (R.W.)
,, palustris, *Müller* ....*	Scarce	Queen's Park (G.S.)
,, ,, var. roseo-labiata	Local	Queen's Park (R.W.)
,, ,, ,, decollata ..	Local	Tarvin Road (H.G.B.)
,, truncatula, *Müller* ..*	Common ..	Roodee Cop (G.S.)
,, ,, var. elegans	Local	Pont Fadoc, Chirk (R.W.)
,, glabra, *Müller* ......*	Scarce	Upton; Christleton (G.S.)
,, ,, var. elongata ..	Scarce ..	Upton; Christleton (R.W.)
Ancylus fluviatilis, *Müller*..*	Common ..	Dee near Llangollen (G.S.), Rossett (E.H.A.)
,, lacustris, *Linné* ....*	Local	Eccleston Road (R.W.), Finchett's Gutter (G.S.)

Terrestrial Shells.

LIMACIDÆ.		
Arion ater, *Linné*..........	Common ..	Upton (G.S.)
,, flavus, *Müller*........	Common ..	Navigation Cop (G.S.)
,, hortensis, *Ferussac*....	Common ..	Sealand (G.S.)
Limax marginatus, *Müller* *	Common ..	Navigation Cop (G.S.)
,, flavus, *Linné*.......*	Common ..	Sealand (G.S.)
,, agrestis ,, ...*	Common ..	Upton (G.S.)
,, maximus ,, ...*	Common ..	Navigation Cop (G.S.)
,, lævis, *Mull*	Common ..	Wrexham (E.H.A.)
TESTACELLIDÆ.		
Testacella haliotidea, *Draparnaud*, var. scutulum	Rare......	Upton Lanes (G.S.)

Name.	Occurrence.	Locality.
HELICIDÆ.		
Succinea putris, *Linné* ....*	Common ..	Queen's Park (G.S.)
,, elegans, *Risso*	Common ..	Queen's Park (G.S.)
,, ,, var. ochracea..	Rare......	Stream nr. Llangollen (G.S.)
Vitrina pellucida, *Müller* ..*	Common ..	Rossett (R.W.), Christleton (G.S.)
Zonites cellarius ,, ..*	Common ..	Water Tower Gardens (G.S.)
,, nitidulus ,, ..*	Local	Wilderness, Gresford (R.W)
,, radiatulus, *Alder* ..*	Scarce	Moston (G.S.), Gresford (E.H.A.)
,, crystallinus, *Müller* ..*	Common ..	Delamere Forest (G.S.)
,, excavatus, *Bean*	Scarce	Gresford (E.H.A.)
,, purus, *Alder* ....*	Scarce	Llandulas (E.H.A.)
,, alliarius, *Müller* ....*	Common ..	Moston(G.S),Gresford(R.W)
Helix lamellata, *Jeffreys*	Rare......	Christleton (H.G.B.), Gresford (R.W.)
,, aculeata, *Müller* ....*	Scarce	Gresford Wood (G.S.)
,, nemoralis, *Linné* ....*	Abundant	
,, ,, var. hortensis *	Abundant	
,, arbustorum, *Linné*	Limited ..	Mold (G.S.), Rossett (R.W) Wrexham (E.H.A.), Holmes Chapel (H,G.B.)
,, ,, var. flavescens	Local ...	Wilderness, Gresford (R.W)
,, virgata, *Da Costa* ....*	Common ..	Rhyl (G.S.)
,, caperata, *Montagu* ..*	Abundant	Navigation Cop (G.S.), Gresford (R.W.)
,, aspersa, *Müller* .....*	Common ..	Christleton; Chester Walls (G.S.)
,, concinna, *Jeffreys*	Scarce	Navigation Cop (G.S.)
,, hispida, *Linné* ......*	Common ..	Sealand Road (G.S.)
,, sericea, *Müller* ......*	Scarce	Sealand Road (R.W.) (G.S.)
,, fusca, *Montagu*	Common ..	Navigation Cop (G.S.), Abergele (E.H.A.)
,, ericetorum, *Müller* ..*	Limited ..	Trevor Rocks (G.S.)
,, ,, var. minor	Abundant	Navigation Cop (H.G.B.)
,, ,, ,, sinistrorsa	Rare	Navigation Cop (R.W.)
,, rotundata, *Müller* ..*	Common ..	Navigation Cop (G.S.)
,, ,, var. pyramidalis	Rare......	Upton (R.W.)
,, rupestris, *Studer*......	Scarce	Navigation Cop (G.S.,
,, pygmæa, *Draparnaud*	Rare......	Navigation Cop (G.S), Rossett (R.W.)
,, pulchella, *Müller* ....*	Common ..	Navigation Cop (G.S.), Gresford (R.W.)
,, ,, var. costata ..	Common ..	Navigation Cop (G.S.), Rossett (R.W.)
,, lapicida, *Linné*	Rare......	Llandulas (E.H.A.)
Bulimus acutus, *Müller* ....*	Common ..	Rhyl (G.S.)
,, obscurus, ,, ...	Rare......	Navigation Cop (G.S.), Wrexham (E.H.A.)
,, montanus, *Draparnaud*	Rare......	Gresford (E.H.A.)
Pupa secale, ,,	Rare......	Rossett; Mold (R.W.)
,, ringens, *Jeffreys*......	Rare......	Abergele (E.H.A.)
,, umbilicata, *Drap*.....*	Common ..	Navigation Cop (G.S.)
,, marginata, ,, ...*	Common .	Navigation Cop (G.S.)
Vertigo antivertigo ,, ...	Rare......	Rhyl (G.S.)
,, edentula, ,, ...*	Rare......	Gresford (E.H.A.)
,, pygmæa, ,, ...	Rare......	Mollington Meadows (G.S.)
,, minutissima, *Hartmann*	Rare......	Rhyl (G.S.)

Name.	Occurrence.	Locality.
HELICIDÆ.—*Continued.*		
Balia perversa, *Linné* ....*	Common ..	Rossett (G.S.)
Clausilia rugosa, *Drap.* ....*	Abundant	Gresford (G.S), Mold (R.W)
,, ,, var. albida ..	Rare......	Rossett (R.W.)
,, laminata, *Montagu*....	Rare......	Hope (E.H.A.)
,, biplicata, ,, ...	Rare......	Llandulas (E.H.A.)
Cochlicopa tridens, *Pulteney*	Limited ..	Gwernymynydd (G.S), Gresford (R.W.)
,, lubrica, *Müller* ......*	Common ..	Gresford (G.S.)
Achatina acicula, *Müller*....	Local	Navigation Cop (G.S.), Rossett (R.W.)
CARYCHIIDÆ.		
Carychium minimum, *Müller**	Common ..	Blacon Point (G.S.), Mollington (R.W.)
CYCLOSTOMATIDÆ.		
Cyclostoma elegans, *Müller*	Limited ..	Trevor Rocks (G.S.), Minera (E.H.A.), Valle Crusis Abbey (E.H.A.), Talargoch (A.O.W.)
Acme lineata, *Draparnaud*	Very rare ..	Blacon Point (G.S.)

REMARKS.

ANODONTA CYGNEA.—In one locality on the borders of Flintshire they occur of large size—6·85 × 3·50.

UNIO MARGARITIFER.—This occurs in the Dee from Bangor Isycoed to Bala. All that I have seen have been small in comparison with those from the Conway River.

DREISSENA POLYMORPHA.—I collected this from the Canal with BELLARS in 1856. My opinion is that it is more abundant now in the Canal than formerly. I have found them clustered together on a stone after the fashion of the young growth of *Mytilus edulis.* They are all of small size. It is rarely that one of typical size is met with.

TESTACELLA HALIOTIDEA, VAR. SCUTULUM.—This variety is now found in some grassy lanes adjoining extensive Nursery grounds. There is the probability of its having been introduced, but it is now acclimatized.

COCHLICOPA TRIDENS.—In "British Conchology" it is said not to have been found in North Wales. We have found it in several localities, usually on the Carboniferous Limestone, or on damp mossy banks.

LIMNÆA STAGNALIS.—We find it in many localities, but only in one locality does it approach the typical character in size.

HELIX ASPERSA.—Altogether absent in the higher table lands of North Wales. Mr. RUDDY reports that in the neighbourhood of Bala, with an altitude of 600 feet, and after careful searching extending over years, he has only met with two specimens, and these were believed to have been introduced with some plants.

SPHÆRIUM OVALE.—Of this scarce but elegant shell we have taken 50 specimens from one locality in the Canal.

On the occurrence of Calcisphæra (Williamson) in the Mountain Limestone of the Eglwyseg Rocks, near Llangollen.

BY GEORGE W. SHRUBSOLE.

Read December 2nd, 1880.

IN the summer of 1878, when in the neigbourhood of Mold, Flintshire, I observed by the road side a heap of limestone, which, by its colour and appearance, attracted my attention. It was a fine grained stone, dark in colour, and thickly studded with minute spherical bodies which, from their size and whiteness, gave a slightly mottled appearance to the stone. The nature of these bodies was somewhat puzzling. Foraminiferal and Radiolarian origin were both suggested. With the view of securing additional information, fragments of the stone were freely distributed, among others to PROF. W. C. WILLIAMSON, F.R.S., by MR. J. D. SIDDALL, with the result that he has described in the Philosophical Transactions,* under the head of *Calcisphæra*, six species of some early form of life. Meanwhile the source of the fragments which contained *Calcisphæra* was unknown, beyond the fact that they were obtained in a mountain limestone country. In the course of last summer I found among the talus at the base of the Eglwyseg Rocks, near Llangollen, a stone identical with the former from near Mold. Subsequently I found the same rock *in situ* some 50 yards higher up, and traced *Calcisphæra* through some 20 feet of exposed limestone rock. I do not think that it is limited even to this area, but there were no facilities for further exploration. I have seen indications which lead me to think, that *Calcisphæra* will be found widely distributed in certain divisions of the limestone. I found this limestone used as road metal in the town of Rhyl.

MR. ARTHUR ACTON informs me that he has traced it for several miles along the outcrop of the lower beds, whenever exposed, at the base of the Eglwyseg Rocks. It may be taken as a fact that *Calcisphæra* is characteristic of, and a leading constituent in, many of the bands of limestone which comprise the lowest series in the lower or basement beds of North Wales.

* Trans. Roy. Soc., p. 520, Part II., 1880.

It corresponds with the lower brown division of MR. G. H. MORTON, F.G.S. The place at which I first observed it, and where it is best seen, is the Ty-nant ravine, two miles from Llangollen.

The rock in which *Calcisphæra* is most abundant is a very pure fine grained limestone, having a clean fracture, and in colour varying from light to dark brown. Scarcely any other form of life than microscopic is present. *Calcisphæra* occurs so freely in some bands, that it may be said to form the limestone. Foraminifera are also distributed throughout these lower beds. These facts would seem to point to a quiet deep sea deposit of moderate depth.

I must not omit to notice the presence of minute crystals, of quartz, which occur in varying proportion, but are present in the purest stone. The only form of life, other than microscopic, which I have seen associated with *Calcisphæra*, is *Euomphalas* sp. and *Murchisonia* sp. In the shales, between the bands of limestone, fossils are more abundant, and include the rare *Producta Llangollensis*, and *Leperditia*, &c.

I have found by chemical analysis that the purer the limestone, the more abundant is *Calcisphæra*. Selected pieces of the stone, full of *Calcisphæra*, yielded over 99 per cent. of Calcic and Magnesic carbonate.

I append an analysis, by GEORGE SHRUBSOLE of the Etruria Laboratory, Hanley, of a typical piece of the limestone. The stone from which fragments were taken for analysis will be found in the Museum, with a polished surface to shew the *Calcisphæra*.

Carbonate of Lime	97·14
Carbonate of Magnesia	1·85
Silica and Silicate of Iron	·47
Iron Oxide and Alumina	·35
Organic matter	·01
Moisture	·28
Phosphoric Acid	traces
	100·10

In bringing this subject forward, my primary object has been to indicate where the limestone containing these remarkable organisms is to be found, and the conditions under which they occur; points which have some relevance in determining their morphological character, and also to offer a few suggestions in defence of the Radiolarian origin of some at least of these organisms.

In naming these organisms *Calcisphæra*, PROF. WILLIAMSON says that he does so "as not involving any premature hypothesis respecting their nature." As to what they really are, he tells us "they are wholly unlike any living organism that we are acquainted with. The spherical form suggests the possibility that they may have been the tests of some extinct form of protozoa . . . Whilst I am thoroughly satisfied that these objects are not Radiolarian, it is not easy to say what they are." *

The objections urged on the part of PROF. WILLIAMSON against their reception as Radiolaria would appear to be—

(*a*) Their not possessing the fenestrated skeleton, which would have allowed the calcareous ooze to penetrate into the sphere cavity;

(*b*) That the structure is different from that of any existing Radiolarian;

(*c*) Inability to understand how the structure of a Silicious Radiolarian could be wholly replaced by Calcic Carbonate.

(*a*) The interior of *Calcisphæra* is filled with Calcite, says PROF. WILLIAMSON, "showing that in life it did not possess the reticulated skeleton, or the interior would now have been filled with the surrounding ooze, and not with Calcite."

This statement as to the infiltration of ooze seems a very natural deduction, but unfortunately it is opposed to facts, which indicate that no absolute rule of this kind can be laid down. There is abundant evidence among the Carboniferous fossils to shew that (with every facility for entering) crystalline calcite, and not the surrounding matrix, now occupies the interior of many fossils. In this condition we find representatives of both *Cephalopoda* and *Gasteropoda*. Here there would be no obstacle to the ooze filling the interior. It doubtless was so filled originally, but has since been removed, and replaced with Calcite. The same thing occurs among the Polyzoa, particularly with the Carboniferous *Fenestella;* for even when this is found in black shale, the interior of the cell is found occupied with white Calcite. As *Fenestella* is closely allied to the Cyclostomatous Polyzoa, its open tubular cells would offer every facility for the infilling with the shale. As a matter of fact they are not so occupied.

The interior of *Calcisphæra* I find, as the result of extended observation, to be in some instances filled with Calcite, in others with the surrounding matrix, and the same is true of many Carboniferous fossils.

Bearing the above in mind, I fail to see that the rule laid down by PROF. WILLIAMSON holds good, that if *Calcisphæra* had possessed the open fenestration of the Radiolaria, the interior would have been filled, not as it is now with Calcite, but with the enveloping material.

(*b*) That the structure of *Calcisphæra* is different from that of any existing Radiolarian: I imagine that the absence in *Calcisphæra* of the peculiar fenestration of the Radiolaria is the

* Trans. Roy. Soc., pp. 523-525, Part II., 1880.

point in question. This resolves itself into a case of careful microscopic observation. It is within the knowledge of all who have carefully studied the Carboniferous Microzoa, that minute organisms have their several parts more or less encrusted with a calcareous covering, which conceals many of the minor details. Hence it would not be surprising if the aperture in the case of a Radiolarian skeleton were obscured. Here, as regards the microscopic appearance, I would prefer to quote from PROF. SOLLAS, who in a letter says "On putting a section of the limestone under the microscope with a power of 500 diameters, I see plainly a number of dark coloured rings, each surrounding a clear crystalline area, and enclosed by the more opaque matrix outside. (The crystalline material affects polarized light.) The dark rings are not continuous, as a section across a continuous spherical shell would be, but interrupted, and in some places net-like in character; from which I infer that they are sections across a spherical network. In many cases a number of dark lines are prolonged from the interior of the dark rings radiately; these appear to be spines. It is unnecessary to say that all these appearances are consistent with a Radiolarian structure, and not with anything else." The observations of PROF. SOLLAS and PROF. W. C. WILLIAMSON are certainly conflicting, but capable of being verified one way or the other.

(*c*) The possibility of the displacement of Silica by Calcite, and the conversion of silicious organisms into calcareous, is, I am aware, somewhat of an innovation upon the teaching of the past. Hence, PROF. WILLIAMSON quotes an authority to the effect—"That I know no agency by which silicious structures could be converted into calcareous." The *modus operandi* may even now not be too well understood, but the fact discovered by SOLLAS and ZITTEL, that the Silica in the structures of various organisms has been wholly replaced by Calcite, has now a well-established reputation, and does not rest upon an isolated case, and is not limited to a particular geological era. It has been observed in cases ranging from Palæozoic to Tertiary times. The fact is that Silica, in the form in which it exists in organic structure, is not the intractible element it was formerly supposed to be. Take the case of the Diatoms of the London Clay. The deposit of these silicious organisms extends for miles as a thick band at the base of the clay, and the whole of the Silica originally present has been removed, and replaced by ferric sulphide. It is not merely a coating, but a solid replacement (Journ. R. Micr. Soc., Ser. II., Vol. I., p. 6.) The number of silicious organisms, available for reference in illustration of this change of substance, is necessarily limited; since, with the exception of the Sponges and Diatoms, there are no silicious bodies of geological importance. The Diatoms are limited to the later geological periods: there remain then only the Sponges to which we can refer.

Concerning the Sponges, PROF. SOLLAS writes—"The line between the calcareous Sponges and the silicious ones is well marked, and no one who knows anything about the Sponges would venture for a moment to doubt that *Siphonia*, *Pharetro spongia*, and *Stauronema*, are fossil *Lithistids*, *Renicrids* and *Hexactinellids* respectively, yet these divisions of the sponges are in a recent state never anything but silicious in composition, while in their fossil representatives they are sometimes silicious, but as often calcareous in composition."

The present notice I am aware by no means solves the problem as to what *Calcisphæræ* really are. My object has been to help on the discussion, and to give additional information as to their occurrence and distribution among the Carboniferous beds, and to shew that the difficulties in the way of their Radiolarian affinities are not so great as imagined by PROF. WILLIAMSON.

My own impression is that among the species of *Calcisphæra* which he has described, future research will show that there are included both Foraminifera and Radiolaria.

In connection with Foraminifera, I may mention that at Minera, at a little higher horizon in the Mountain Limestone than the present, there are several bands of stone, amounting altogether to some twenty feet in thickness, in which Foraminifera are specially abundant, and particularly *Saccammina Carteri* (Brady), which in some of the layers has almost exclusive possession of the stone. The quarry in which the best exposures are to be seen, is at the back of the office of the Minera Lime Company. This Saccamminal Limestone, on analysis by my son, gave the following results:—

Carbonate of Lime	95·26
Carbonate of Magnesia	2·33
Insoluble Silicates	·65
Iron Oxide and Alumina	1·47
Moisture	·27
Organic matter and Phosphoric Acid	traces
	99·98

On the occurrence of Venus Mercenaria (Lin.) in the Estuary of the Dee.

BY GEORGE W. SHRUBSOLE.

ON Wednesday, September 27th, 1882, I visited Hilbre Island, for the purpose of collecting Natural History objects, for the Conversazione of our Society. I noticed at various points along the margin of the current, which runs by the side of the Island a shell of the Venus type, like a great cockle, as large as an average sized orange. It was new to me, and I accordingly sent a specimen to MR. F. P. MARRATT, of Liverpool, who informed me that it was the *Venus Mercenaria*, a North American species, the Wampum Clam of the North American Indians.

Its occurrence at Hilbre was an interesting fact, which needed some explanation. It was not a stray shell brought there by some accident, since I obtained over 100 specimens of either one or both valves. I found on enquiry, that 14 years ago MR. T. V. MOORE, F.Z.S., of Liverpool, deposited some live Clams on the various sandbanks in the estuary of the Mersey. So far as is known, this attempt at acclimatization proved a failure, and cannot be connected with the present find. In December, 1879, a MR. BRANDRETH laid down, for store purposes, a barrel of Clams, in the shallow water around the Island. This, I consider, gives the clue to my finding the shells. The interesting point to be here noticed is that there is good reason for inferring that the Clam has bred on our Cheshire Coast. The evidence for this we have in the size of some of the shells (certainly only a few months old), and the circumstance that the last dispersion of live Clams was two years and ten months prior to the time of my finding them. Further, the fresh appearance of the shells, the absence of erosion, the ligament still perfect, shewed that the Clam must have been living within a week or two. These attempts at acclimatization we can only regard as more or less a failure ;

for while the conditions, under which the second deposit was made, were on the whole more favourable to the colony, so that some did struggle through an existence for two or three years, yet there is no ground for supposing that any now exist in the waters around Hilbre Island. The mistake would appear to have been in treating the Clam as a marine species, instead of an inhabitant of brackish water.

It may be of interest here to mention that, thanks to Mr. Moore of Liverpool, another and we may hope a more successful attempt to introduce the Clam was made last summer. This time our own river, the Dee, has been selected for the experiment. Some hundreds of these popular mollusks are, we may hope, thriving and multiplying in the more brackish waters of the Dee.

It is scarcely desirable to mention the spots where they are placed. It will be sufficient to say that they are between the White House in the upper waters of the Dee, and Connah's Quay. They have also been laid down near Bagillt, at the mouth of the Clwyd, and at Colwyn Bay. If the Clam can be successfully cultivated in our tidal streams, there is very little doubt but that it will prove a formidable rival of our *Ostrea edulis*.

Specimens of the shell may be seen in our Museum.

List of Caradoc or Bala Fossils found in the Neighbourhood of Bala, Corwen, and Glyn Ceiriog.

BY THOMAS RUDDY, PALÉ, CORWEN.

IN the typical Bala district, the series is divisible into several zones or sub-divisions, each of which have characteristic fossils (see Section.) These zones are usually divided from each other by barren shaly beds, often ashy. which sometimes are of considerable thickness. The ashy beds are either fine and compact, or composed of breccia, and in the latter case are often calcareous, and yield an occasional fossil.

The zones 2, 3, and the fossiliferous part of 4, do not occur at Bala, but they are highly developed in the mountains south of Corwen, and at Glyn Ceiriog, south of Llangollen. The zones 5, 6, 7, 8, are best developed at Bala and Glyn Ceiriog. Zone 9 is poorly represented in the mountains south of Corwen, but it is well developed further south at Milltir Gerig on the Bala and Llangynog road, under the eastern outcrop of the Bala limestone, and again near Bala in various places under the western outcrop of the Bala limestone. Its stratagraphical position is immediately above the "Little Ash" (see Memoirs of Geological Survey, Vol. III., page 220), which may be seen on the Geological Maps as a narrow red streak running in a broken line, parallel to the blue line of the Bala limestone, and about 800 feet below the limestone. Zone 1 is best developed in the Hirnant Valley S.E. of Bala; it is known as the Hirnant bed, and is composed of fossiliferous sandy shales, compact grits, and a thin band of black Pisolitic limestone. A thick bed of blue slaty shales divides it from the Tarannon shales. These same grits and blue slaty shales occur under the Tarannon shales at Corwen, but the pisolitic limestone and characteristic fossils are absent.

We meet with a thin band of grey limestone at Glyn Ceiriog in zone 2, and a very thin concretionary grey limestone occurs in the same zone at Corwen. The compact grits and blue slaty shales again occur at Glyn Ceiriog above the upper limestone, and under the Tarannon shales. It might be inferred that the upper limestone at Glyn Ceiriog and the Hirnant limestone at

Bala are of the same age, because they appear to occupy corresponding positions, but there is no satisfactory fossil evidence to justify this conclusion. The most characteristic fossils in the Hirnant limestone at Bala are absent in the upper limestone at Glyn Ceiriog, and the most characteristic fossils found in the Glyn Ceiriog upper limestone and associated shales are absent in the Hirnant limestone. Any species common to both may be found in all the zones.

Some of the species found in zone 2 give it a Lower Llandovery character, but true *Pentameri* are never found in it.

CHIEF FOSSIL LOCALITIES.

The names of Localities will be easily found on the Ordnance Map.

A.—Berwyn Phosphate Mine, S.E. of Bala, situated near Trwyn Swch at the head of the Llangynog Valley in the Berwyns. Fossils at Mine.

B.—Blaendinan near Llandrillo, W. of Corwen. Fossils in the loose stones and rocks near the little brook where the Bala limestone crosses the mountain road. 4

C.—Brynbedwog, S. of Bala lake. Fossils abundant in the rocks and walls about the farmhouse.

D.—Bryn-cut at Rhosygwaliau, S.E. of Bala. Fossils in the rocks on the roadside nearly opposite the vicarage. 8

E.—Bryntirion, about a mile W. of Corwen. Fossils in the wood above the road, where there are several quarries. 4, 2, 3

F.—Bryngwyn, S. of Bala Lake. Fossils in the old lime quarries and wall where the limestone crops out on the hill side.

G.—Bwlch-y-gaseg, S. of Corwen. Fossils in the loose stones and outcrops of rock along the mountain road leading from Cynwyd to Moel Ferna. 2, 3, 4

H.—Bwlch-hannerob, S.E. of Bala. Fossils in the Hirnant zone near the farmhouse, and in the wood down to the River Dee.

I.—Cefn-y-Coed at Glyn Ceiriog, S. of Llangollen. Fossils along the lower limestone outcrop, and especially in the quarries above Dolhir. 5

J.—Cerig Coedog, S.E. of Corwen. Fossils along the rocky ridge S. of Moel Ferna, where the boundary divides the counties. Several zones here. 2, 3, 4, 5

K.—Cornelau, S. of Bala Lake. Fossils in the walls near the farmhouse, and in the rocks immediately above the "Little Ash" bed.

L.—Cwm-onen, at E. base of Moel Emoel, N. of Bala. Fossils in the rocks and walls at and W. of farmhouse.

M.—Cwm-yr-aethnen, Hirnant valley, S.E. of Bala. Fossils in Pisolitic limestone and shales, at the roadside limekiln opposite the Shepherd's house.

N.—Garnedd, E. of Bala Lake. Fossils near the farmhouse, in the walls and quarries where the limestone crops out.

O.—Garwfynyd, near Moel Emoel, N. of Bala. Fossils in the rocks where the "Little Ash" bed crops out on the N. side of the hill.

P.—Gelli-grin, S.E. of Bala. The limestone is well developed here, and fossils are plentiful near the farmhouse in walls and quarries.

Q.—Glynbach, near Llangower, S. of Bala lake. Fossils in the shales, and circular patch of limestone on the hill side.

R.—Llwyn-y-ci, near the mansion of Rhiwlas, N. of Bala. Fossils in the walls, and at quarries in the limestone near the farmhouse.

S.—Maeshir, near Aberhirnant, S.E. of Bala. Fossils in the Hirnant limestone above the road, W. of the farmhouse.

T.—Milltir Gerig, in the Berwyns, S.E. of Bala. Fossils in the shales on the side of the upper road at the head of Llangynog valley.

U.—Moelgarnedd, W. of Bala. Fossils in the walls and quarries where the "Little Ash" bed crops out W. of the mansion.

V.—Nant Iorwerth, at Glyn Ceiriog, S. of Llangollen. Fossils plentiful in a quarry near the brook at the farm of Tynyfron, S. of Glyn.

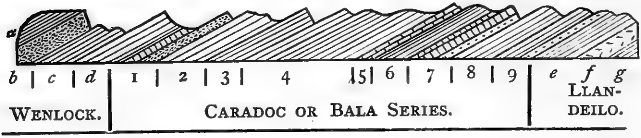
W.—Pont Hafodgynfor, at Glyn Ceiriog, S. of Llangollen. Fossils in the upper limestone and shales in the wood near the bridge.

X—Pont-y-glyn, on the Holyhead road, N. of Bala. Fossils in the limestone and shales at the bridge.

Y—Tyn-y-fach, near Llandrillo, W. of Corwen. Fossils in quarries between the farmhouse and road leading from village to Berwyn road passing Blaen-dinan.

Z—Fronderw or Vronderw, N.W. of Bala. Fossils in the quarry and walls near the "Little Ash" bed at the back of the house.

Diagrammatic Section, showing General Order of the Subdivisions in the Bala Series.



a—Flaggy beds.

b—Denbigh grits.

c—Graptolite shales.

d—Tarannon shales.

1—Hirnant grits, limestones, and shales, containing *Orthis Hirmantensis*, *O. sagittifera*, *O. biforata*, &c.

2—Calcareous shales, containing *Orthisina ascendens*, *Meristella*, *Pterinea*, *Ambonychia*, *Murchisonia*, *Echinoderms*, &c.

3—Polyzoa in abundance, especially *Phyllopora*, *Ptilodictya*, &c.

4—Like the last zone, this is composed of fine sandy shales, the greater part being barren; the fossiliferous zone is at the top, and contains several species of *Trilobites*, a few *Echinoderms* and dwarf *Polyzoa*, small *Brachiopods*, &c.

5—This zone represents the Bala crystalline limestone and coarse sandy shales, containing *Cephalopods*, *Cystideans*, *Univales*, *Lingula ovata*, *Orthis Actoniæ*, *O. calligramma*, &c.

6—Sandy shales, containing *Asaphus Powisii*, *Homalonotus*, and small *Brachiopods*.

7—Sandy limestone resting upon an ash bed; the sandy limestone is full of *Orthis vespertilio*, and *O. spiriferoides*.

8—Calcareous shales, full of *Leptæna*, *Orthis elegantula*, *Strophomena expansa*, *Beyrichia*, and *Cythere umbonata*.

9—Sandy or fine shales resting upon an ash bed. The shales contain various species of *Brachiopods*, but the most abundant is *Orthis alternata*, and it is confined to this zone.

e—Dark earthy fossiliferous shales.

f—Felspathic ash.

g—Fossiliferous shales.

LIST OF CARADOC OR BALA FOSSILS.

Names and References.	Zones.	Localities.	Remarks.
AMORPHOZOA.			
Ischadites tessellatus, Salter, M.S.	2	W.	A very rare sponge.
Cliona Vioa, sp.	2	W.	Very rare. Minute borings in a Brachiopod.
ACTINOZOA.			
Stenopora fibrosa, Goldf	1 2 3 4 5 6 7 8 9	General	Very common in all localities and zones.
" " var. *lycoperdon*, Hall	1 2 3 4 5 6 7 8 9	General	Common, and associated with the last.
" " " *incrustans*, McCoy	1 5 8	C.L.M.	A rare variety, found encrusting shells.
" " " *regularis*, McCoy	2 3 4 5 8	G.P.	A tabulate variety.
Favosites asper, d'Orb	2 4	G.W.	Rare.
" *Gothlandica*, Linn.	5	I.W.	Frequent in the limestone.
Halysites catenularius, Linn.	2 3 4 5	I.W.	Frequent, and associated with the last.
Heliolites tubulatus, Lons.	2 3 4 5	I.J.W.	Occasionally encrusting an Orthoceras. Frequent at I., rare elsewhere.
" *megastoma*, McCoy	2 4 5	J.W.	Rare.
" *interstinctus*, Wahl.	5	I.	Rare.
" *subtubulatus*, McCoy	5	I.	Rare. [Glyn Ceiriog.
Nebulipora lens, McCoy	2 3 5	I.J.P.W.	This globular form is scarce at Bala, but frequent at
Omphyma turbinata, Linn.	5	I.	Frequent in the lower limestone.
Cyathophyllum, sp	5	I.	Rare.
Petraia æquisulcata, McCoy	2 3 4 5 8	G.I.J.R.W.	Frequent at G.J.W.; very rare at Bala.
" *subduplicata*, McCoy	1 2	G.I.J.W.	Frequent.
" *rugosa*, Phill	5	J.P.	Rare.
" *elongata* (?), Phill.	5	P.	Rare.
" *uniserialis*, McCoy	2 3	G.J.W.	Frequent.
Syringophyllum organum, Linn.	2	W.	Rare.
ECHINODERMATA.			
Echinosphærites Balthicus, Eichw.	2 3	E.G.J.	Rare. Occurs in shales.
" *granatus*, Wahl.	5	R.	Rare. Occurs in the limestone at R.

NAMES AND REFERENCES.	ZONES.	LOCALITIES.	REMARKS.
ECHINODERMATA—*Continued.*			
Sphæronites pyriformis, Forbes	5	R.	Frequent. In the limestone with last.
,, *munitus*, Forbes	5	R.	Frequent. This and two following with last.
,, *punctatus*, Forbes	5	R.	Scarce.
,, *Litchi*, Forbes	5	R.	Rare.
Hemicosmites oblongus, Pand.	2	G.W.	Very rare. The three occur in shales.
,, *squamosus*, Forbes	4	E.G.	Very rare.
,, *rugatus*, Forbes	4	G.R.	Very rare.
Pleurocystites Rugeri, Salter	4 5	G.R.	Rare. Occurs in shales and limestone.
Glyptocrinus basilis, McCoy	1 2 3 4 5 6 7 8 9	General	Common and general. Pentagonal at Y.
Palæaster obtusus, Forbes	8 9	P.M.	Very rare. Occurs in shales.
ANNELIDA.			
Cornulites serpularius, Schlot.	1 9	S.U.	Very rare. Occurs in limestone and shales.
Tentaculites anglicus, Salter	2 3	G.J.	Frequent. Occurs in shales.
Serpulites—species like *longissimus*	2 3 4 5	G.J.R.	Scarce. It may be *S. dispar* of Salter.
Burrows, &c.	1 2 3 4 5 6 7 8 9	General	Common and general.
CRUSTACEA.			
Beyrichia complicata, Salter	5 6 7 8 9	General	Very common about Bala.
Cythere (Leperditia) umbonata, Salter	2 5 6 7 8 9	G.K.L.N.P.T.U.	Very common about Bala; very rare at Corwen.
,, large species, new	2	J.	Very rare.
Acidaspis Brightii, Murch.	2	J.	Very rare and imperfect.
Agnostus trinodus, Salter	5	R.	A very minute species.
Ampyx tumidus, Forbes	5	R.	Frequent but imperfect.
Asaphus Powisii, Murch.	4 6 7 8 9	A.C.G.P.T.U.V.W.	Frequent but imperfect.
Calymene senaria, Conrad	2 3 4 5 6 7 8 9	General	Frequent and perfect.
,, *Blumenbachii* var. *caractaci*, Salter	2	G.J.	Frequent and perfect at J., scarce at G.
Cheirurus bimucronatus, Murch	3 4	G.R.W	Perfect but rare.
Cybele verrucosa, Dalm	4 6	G.P.	Rare and seldom perfect.
Encrinurus sexcostatus, Salter	5	L.R.	Frequent but imperfect.
Harpes, sp.	3	G.	Very rare and seldom perfect.
Homalonotus bisulcatus, Salter	1 2 5 6 7 8 9	General	Frequent but rarely perfect. Very rare at H.
Illænus Bowmanni, Salter	2 3 4 5 6 7 8 9	General	A general species but seldom perfect.

Illænus Davisii, Salter	2 3 4 5 9	G.R.W.	Frequent at R., rare elsewhere.
Lichas laxatus, McCoy	5 6	P.R.	Scarce and imperfect.
Phacops Brongniartii, Portl.	3 4	F.G.R.W.	Perfect but rare.
,, *alifrons*, Salter	5 6 7	F.P.O.	Frequent at P., but imperfect.
,, *macroura*, Siogren	2 3 8	G.J.V.	Very rare and imperfect.
,, *conopthalmus*, Bœck	2 3	G.	Very rare and imperfect.
,, *apiculatus*, Salter	3 4 6	F.G.P.	Rare and seldom perfect.
,, sp.	4	B.	Very rare.
Primitia strangulata, Salt	2	W.	Rare. Very minute and easily overlooked.
Remopleurides Colbii, Portl.	3 4	G.	Perfect but rare.
Trinucleus concentricus, Eaton	3 4 5 6 7 8 9	General	Common but rarely perfect.
,, *seticornis*, His.	4 5	B.G.R.	Frequent and perfect.
POLYZOA.			
Pinnatopora Sedgwickii, Shrubsole	2 3 4	E.G.J.W.	Not found at Bala.
Berenicea heterogyra, McCoy	9	U.	Very rare.
Fenestella, (?) sp.	3	G.	Very rare.
Phyllopera Hisingeri, McCoy	2 3 4 5 6 7 8 9	General	Very rare at Bala.
,, sp	2 3 4	G.J.W.	Frequent.
Ptilodictya costellata, McCoy	2 3 4	G.J.W.	Common. Neither of these occur at Bala.
,, *explanata*, McCoy	2 3 4	G.J.W.	Very common.
,, *dichotoma*, Portl	2 3 4	G.J.W.	Frequent.
,, *fucoides*, McCoy	2 3	G.J.	Scarce.
,, sp.	3	G.	Scarce.
BRACHIOPODA.			
Crania divaricata, McCoy	5	P.	Very rare.
Discina crassa, Hall	2	J.	Very rare.
,, *oblongata*, Portl.	3 4 5	B.G.P.	Frequent.
,, *Siluriana*, Dav.	2	J.	Very rare.
Leptæna quinquicostata, McCoy	5	R.	Scarce.
,, *sericea*, Sow.	2 3 4 5 6 7 8 9	General	Very common everywhere.
,, *tenuicincta*, McCoy	3 5	G.J.R.	Frequent at G. and J., rare at R.
,, *transversalis*, Dalm.	2 3 4 5 6 7 8 9	General	Common everywhere.
,, *scissa*, Salter	2 3 4 5 6 7 8 9	General	Frequent, but easily overlooked.
Lingula ovata, McCoy	5 6 7 8 9	F.H.N.O.P.	Frequent at P., rare elsewhere.
Meristella crassa, Sow.	2	J.	Common but local.
,, *subundata*, McCoy	2	J.	Very rare.
Orthis Actoniæ, Sow.	3 5 6 7 8	General	Common at Bala, rare at G.

Names and References.	Zones.	Localities.	Remarks.
BRACHIOPODA—*Continued.*			
Orthis alternata, Sow.	9	K.O.T.U.X.Z.	Very abundant everywhere in Zone G.
„ *biforata*, Schl.	1 2 3 4 5 6 7	General	Common at M. and S., scarce elsewhere.
„ *calligramma*, Dalm.	2 3 4 5 6 7 8	General	Very common about Bala.
„ *crispa*, McCoy	2 3 4	G.J.W.	Scarce.
„ *elegantula*, Dalm.	1 2 3 4 5 6 7 8 9	General	Very common everywhere.
„ *flabellulum*, Sow.	2 3 4 6 7 8 9	General	Common at G. and J., scarce elsewhere.
„ *Hirnantensis*, McCoy	1	H.M.S.	Common but local.
„ *insularis*, Eichw.	2 4 7	B.D.G.J.	Rare.
„ *porcata*, McCoy	2 3 4	B.G.J.Y.	Scarce.
„ *sagittifera*, McCoy	1	H.M.S.	Common but local.
„ *spiriferoides*, McCoy	2 3 4 5 6 7 8 9	General	Very abundant at Bala, scarce at G. J. W.
„ *testudinaria*, Dalm.	1 2 4 5 6 7 8 9	General	Frequent.
„ *vespertilio*, Sow.	7 8 9	A.K.N.P.T.Z.	Very plentiful where it occurs.
Orthisina ascendens, Pand.	2	G.J.W.	Very frequent and fine at G. and J., scarce and poor at W. This fine shell has spiral coils.
„ „ var.	2	G.J.	This variety is very beautifully sculptured, more so [than *Orthis crispa*.
Strophomena antiquata, Sow.	3	G.	Very rare.
„ *corrugatella*, Dav.	4	G.	Very rare.
„ *deltoidea*, Conr.	3 5	General	Frequent at P., rare at G.
„ *depressa*, Dalm.	2 3 4 5 6 7 8	General	Very common and general.
„ *expansa*, Sow.	8	D.K.O.P.T.V.	Common where it occurs.
„ *pecten*, Linn.	2 3 4	B.G.J.W.	Very common at G. and J., rare elsewhere.
„ *ungula*, McCoy		V.	Gregarious at V.
Triplesia Maccoyana, Dav.	5 6 7	F.N.P.	Rare. The *Athyris depressa* of Sow.
CONCHIFERA. (Monomyaria.)			
Ambonychia undata, Hall	2	W.	Very rare.
„ *Triton*, Salter	2	J.	Rare.
„ *trigona*, Portl.	2 3	G.J.	Rare. [limestone.
„ *striata*, Sow.	2	J.	Rare. This is not the *A. radiata* of the Trenton
Pterinea pleuroptera, Conr.	2	J.	Rare but well preserved.
„ *retroflexa*, Wahl.	2	J.	Very rare.
„ sp.	2	G.J.	Very rare. This resembles *Pt. planulata*, Conr.

(DIMYARIA.)			
Arca (?) Edmondiæformis, McCoy	1 2	G.M.S.	Frequent at S., rare elsewhere.
Cleidophorus ovalis, McCoy	9	T.	Rare.
Ctenodonta obliqua, Portl.	8	D.	Very rare.
" *transversa*, Portl.	2 5	J.R.	Rare.
" *varicosa*, Salter	2 3 4 5 9	G.J.U.W.Z.	Common west of Bala, scarce elsewhere.
" *radiata (?)* Portl.	2	J.	This is striated longitudinally. Very rare.
" sp.	2	J.	Very rare.
" "	2	J.	Very rare.
" "	2	J.	Very rare.
" "	8	V.	Common.
" "	2	J.	Very rare. This is like *Ct. Anglica*.
Modiolopsis expansa, Portl.	2	J.T.	Rare.
" *inflata*, McCoy	2 8 9	L.T.V.	Frequent.
" *modiolaris*, Conr.	1 2 3 4 5 6 7 8 9	General	The common species.
" *obliqua*, Sow.	3 4 5	G.P.	Rare.
" *orbicularis*, Sow.	2	J.	Rare.
" *postlineata*, McCoy	2 8 9	C.G.U.	Very rare at G., rare elsewhere.
" sp. like *M. gradata*, Salter	2	G.J.	An interesting and rare little species.
" *pyrus*, Salter	1	S.	Local species.
" sp.	2	J.	Rare and beautiful species.
Orthonota nasuta, Conr.	1 2	H.J.	Very rare.
Palaearca bulla, Salter	1 4 8	General	Frequent at S. and V., rare elsewhere.
" *modiolaris*, Salter	5	P.	Rare.
" sp.	8	N.	Rare.
GASTEROPODA.			
Cyclonema crebristria, McCoy	7	A.N.P.	Frequent where it occurs.
Euomphalus sculptus, Sow	2 3 4	G.J.W.	Rare.
Holopea carinata, Forbes	5	R.	Rare.
" *conica*, Forbes	5	R.	Frequent but local.
" *exserta*, Forbes	5	R.	Frequent but local.
" *lymnæoides*, Forbes	[illegible]	R.	Rare and local.
" *striatella*, Sow.	4 5 6 7 8 9	General	Scarce, but the most generally distributed.
" sp.	1	S.	Rare. This is a smooth species.
Holopella, sp., very like *Murchisonia gracilis* of Trenton beds.	5	R.	Frequent but local. A smooth species.
Murchisonia gyrogonia, McCoy	8	L.	Rare.

Names and References.	Zones.	Localities.	Remarks.
GASTEROPODA—*Continued.*			
Murchisonia simplex, McCoy	2 3 4	J.W.	Frequent.
Raphistoma æqualis, Salter	2 5	G.J.R.	Scarce.
,, *lenticularis*, Sow	2	W.	Rare.
,, sp.	2	J.	Rare. Very large species.
Trochonema triporcata, McCoy	2 3	G.J.W.	Frequent at G. and J., rare at W.
HETEROPODA.			
Bellerophon acutus, Sow.	4	B.G.	Rare.
,, *bilobatus*, Sow.	2 3 4 5 6 8 9	General	Frequent and the most general.
,, *carinatus*, Sow.	2 4 8	G.T.V.W.	Common at V., rare elsewhere.
,, *expansus*, Sow.	5	R.	Very rare.
,, *nodosus*, Salter	2 3 4	G.J.W.	A very beautiful and scarce species.
PTEROPODA.			
Conularia Sowerbyi, Defr.	2 3 4 5	B.G.J.P.W.	Frequent at B. G. and J., scarce elsewhere.
Theca reversa, Salter	2 3 4 5	G.J.R.	Scarce.
,, sp.	5	R.	Very rare.
,, sp.	4	B.G.	Very rare.
CEPHALOPODA.			
Cyrtoceras atramentarium, Salter	5	R.	Scarce.
,, *inæquiseptum*, Portl	2	J.	Very rare.
,, *sonax*, Salter	2 5	G.Q.R.	Frequent at Q. and R., very rare elsewhere.
Lituites cornu-arietes, Sow.	2 4 5	G.J.P.R.	Rare.
,, *planorbiformis*, Conr.	5	R.	Very rare.
Ormoceras sp.	5	P.	Very rare.
Orthoceras audax, Salter	5	R.	Scarce.
,, *angulatum*, Wahl.	2 4	G.J.	Rare.
,, *annulatum*, var. *fimbriatum*, Sow.	3	G.	Rare.
,, *Ibex*, Sow.	2 3 4 5	General	The most generally distributed.
,, *vagans*, Salter	2 3 4 5	B.F.G.J.R.	Very common at R., rare elsewhere.
,, sp.	5	R.	Scarce.
,, sp.	5	R.	Scarce.

TERMS USED IN THE LIST.

"Very rare," when only one or two specimens of the species have been found.
"Rare," when two or three have been found.
"Frequent," when several have been found.
"Scarce," when occurring here and there at long intervals.
"Common," and "Very common," when plentiful and general.

NOTES.

Orthisina ascendens. The dorsal valve of this interesting fossil is but imperfectly known to palæontologists. MR. DAVIDSON, in his Silurian *Brachiopoda*,* figures only the ventral valve, and PROF. McCOY says of it—"I have not seen the entering (dorsal) valve of this species, but according to DE VERNEUIL and PANDER it is about half the depth of the receiving (ventral) valve."†

I have been fortunate enough to get together a fine series of this valve from the hills south of Corwen, and above the village of Cynwyd. The series includes casts both of the interior and exterior shells of both valves. I have also examples of both valves attached. In the interior of one specimen is seen the spiral coils common to the *Brachiopoda*. The specimens I have put down as a variety of *Orthisina* differ essentially from it in the sculpturing on the exterior surface, which is similar to *Strophomena corrugatella*, figured in DAVIDSON'S Silurian *Brachiopoda*, Plate 41, figs. 11 and 12. There is a doubtful specimen of the dorsal valve in the Museum of Practical Geology in Jermyn Street.

Agelacrinus Buchianus (Forbes), *Protaster Salteri* (Forbes), and one or two other species seen in other collections from this neighbourhood, have been found in zones 8 and 9.

The list of fossils found in the Caradoc beds of North Wales, given in the third volume of the Memoirs of the Geological Survey, needs correction in some of its details. Several of the species given in the list are very doubtful, especially the *Graptolites*, said to have been found in localities doubtfully referred to Bala beds. MR. SALTER, in the same memoir, says § that *Graptolites* are absent in the Bala beds, while in the Cambridge Catalogue of Fossils, *Graptolithus priodon* and *Grap. sp.* are given as Middle Bala species (Caradoc beds) from North Wales, but Peniarth ucha, N.W. of Pen-y-glog at Corwen, the locality given for this fossil, is suspiciously near to the slate

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*Palæontographical Memoir, Vol. vii., Plate 49, No. 4.
† Sedgwick and McCoy, Br. Pal. Foss., p. 231.
§ Geological Memoir, North Wales, p. 272.

quarry of Pen-y-glog, situated at the base of the Wenlock beds, where *Graptolithus priodon* is in abundance. The exact locality of the other species is unknown.

The species of Fenestella given in both of the above lists are also very doubtful. I very much question whether we have a true Fenestella in our North Wales Bala beds. I have seen three so-called species (*Fenestella assimilis*, *F. subantiqua*, and *F. regularis*) in the London Museums, but they were only specimens of *Phyllopora* and *Ptilodictya*. Mr. Shrubsole confirms this opinion as to the absence of Fenestella.

The collecting of the above, and the working up of the various zones, has been the careful labour of over ten years. A few other things remain to be classified when better specimens are found.

Here I wish to acknowledge the assistance I have received from Mr. Shrubsole in working out the fossils, more particularly of the Glyn Ceiriog district, with which he has long been familiar.

The American Water Weed, Anacharis Alsinastrum, Bab.: Its Structure and Habit; with some Notes on its introduction into Great Britain, and the causes affecting its rapid spread at first, and apparent present diminution.

WITH PLATE.

BY J. D. SIDDALL.

Read before the Botanical Section of the Chester Society of Natural Science, March 8th, 1883.

ALTHOUGH it is not yet half a century since the first introduction of *Anacharis Alsinastrum* from America, its subsequent spread has been so rapid that it is now one of the commonest plants in Great Britain. The circumstances attendant upon this remarkable increase, and the physical conditions and structural peculiarities which have combined to bring it about, present questions of the deepest interest, and which I here propose briefly to discuss.

Anacharis Alsinastrum, Bab., the American Water Weed, or Water Thyme as it is sometimes called, is a Monocotyledonous plant belonging to the Natural Order, Hydrocharideæ. Two other British plants only belong to the same order, viz.:—*Hydrocharis morsus-ranæ*, the Frogbit, and *Stratiotes aloides*, Water-soldier.

Frogbit is common everywhere in our district. Its round, kidney-shaped floating leaves and pretty delicate white flowers form a complete covering over the surface of many ponds and sluggish waters. It rarely produces seed, and is chiefly reproduced by compact "winter-buds," which become detached upon the decay of the parent plant, and remain dormant through the winter, either floating on the surface or sinking to the bottom, and renewing the plant each spring. The long, simple unbranched roots, thickly covered with root hairs, render the plant a very striking one in an aquarium; and the cells of the transparent stipules show well the phenomenon of rotation of the protoplasm.

Water-soldier is much more rare, and almost unknown in our district, having, through drainage and other causes, quite recently disappeared from several localities where it formerly grew. It has rigid, dark green aloe-like leaves, and grows on the bottoms of lakes and ponds, rising and floating only when in flower.

Anacharis Alsinastrum (see fig. 1,) is very distinct in appearance from either of the two plants previously named; and is so, in fact, from any other British plant. It has long, slender, round stems, branching at irregular distant intervals, green when young, becoming brown with age. The stems vary from a few inches to three or four feet in length, but seldom exceed one-eighth of an inch in diameter; and they bear small oval pellucid dark green leaves in whorls of three or four at close intervals. Long, thin, simple unbranched roots, which either penetrate the mud or hang down in the water, are also developed at irregular distant intervals. The stem is readily broken at the nodes, and each node possesses the power of reproducing the plant under favourable circumstances; see fig. 5, which shows how slight is the connection of the cellular nodal tissue.

Thin vertical sections of the older brownish stems in winter form very beautiful and most interesting studies in vegetable morphology and physiology (see fig. 5.) The stem is strengthened by a central axis of fibrovascular tissue, which shows in a very clear manner the characteristic peculiarities of such tissue in aquatic plants. Some of the vessels of this axial cylinder are marked with very faint spirals, but these are never definite, and the wood cells are never thickened or lignified. At the nodes these cells are much smaller, and produced inwardly, thereby constricting at that point the central air cavity. Strands of these cells bend outwardly and form connections between the midribs (the only nerves) of the leaves and the axial cylinder (see fig. 5, *l. t.*) This central axis is bounded by large loose cellular tissue, with frequent *lacunæ* or air passages. These large cells are thin-walled, and their protoplasm contains chlorophyll granules, which in winter are wholly or partially replaced by starch granules, forming a reserve store of nourishment to be drawn upon by the plant in its next year's growth. These starch-containing cells are still lined with active protoplasm, which moves within them in varied manner, carrying the starch granules along with it. Those who are familiar with the appearance presented by starch when viewed with polarised light will readily imagine what a remarkable sight such a phenomenon presents. As a rule, cells which contain stored starch in any quantity are devoid of active protoplasm; but these stem cells of Anacharis are an exception, and thin sections well shown form one of the most attractive microscopic objects it is possible to conceive. Sometimes the granules will for a time gyrate regularly within the cell, and then start off at a tangent and follow each other in single file through most intricate paths, the while changing colour as the polarizing prism is revolved, forming ever changing kaleidoscopic pictures of wonderful beauty.

In no plant perhaps is the growing point *(punctum vegetationis)* of the stem more easily prepared for study than in Anacharis. All that is necessary is to strip off the lower enveloping leaves until the apex of the stem is exposed as a white point. Microscopical examination of this then reveals in an unusually clear manner the acropetal development of the leaves, and the long cone of small-celled protomeristem tissue which forms the growing point. See fig. 2; in which the youngest leaves appear as mere prominences of the meristem tissue above, and gradually grow into the normal form below; the older leaves, which had curved over and so protected the tender growing point, having been torn away below to expose both the apex of the stem and the glands (fig. 2, *g.*) described below.

The leaves are sessile, from $\frac{1}{8}$th to $\frac{1}{4}$th of an inch in length, oval to linear in form, acute and margined; and are arranged upon the stem in whorls of threes or fours above,—opposite below. As in all submerged aquatic plants, they are not covered with a distinct epidermis, nor are the superficial cells cuticularised. Consequently the cell walls are very transparent, permitting a clear view of their contents, and also of the phenomenon of cyclosis, which they show in a very high degree. The leaf border consists of a single layer of cells, the apices of some of which are produced into little teeth forming a distinctly serrated margin. Nearer the central rib the cells are two or three deep. The central rib itself consists of elongated cells, which, as already stated, are in direct connection with the central axis of the stem. (fig. 5 *l. t.*) In Science Gossip for 1869, Mr. T. Simpson gives the following particulars respecting the structure of the leaves of Anacharis:—

Averages of	Size.	No. of Cells.	No. of Chlorophyll Granules in each cell.	No. of ditto in whole leaf.
12 Leaves	$\frac{24}{100} \times \frac{7}{100}$	9,100	23	209,300
6 Leaves	$\frac{22}{100} \times \frac{6}{100}$	9,750	22	214,500

A rather high power is necessary to see the cyclosis to perfection, but it well repays the trouble of careful illumination and examination with a $\frac{1}{10}$th or $\frac{1}{16}$th inch objective, for in addition to the ordinary rotation round the interior of the cells of a dense layer of protoplasm in which the chlorophyll granules are carried, there is then also brought into view a network of exceedingly fine anastomosing threads of protoplasm which traverse the cell cavity in all directions.

The great advantage of Anacharis leaves as a subject in which to observe cyclosis, is the fact that they need no slicing. A rather old—sometimes slightly yellow leaf by preference—torn from the stem and laid in a drop of water on a glass slip, and covered with a good sized cover glass, generally exhibits movements of the cell contents in a few minutes; commencing as a rule in the cells near the base and centre of the leaf. If kept wet and warm, the movement continues for many hours.

In the axil of each leaf there are two tiny, flattened pear-shaped, exceedingly transparent glands (see figs. 2, *g.*; 3; 5, *g.*) Each gland consists of a double layer of thick-walled cells densely filled with granular protoplasm, and possessing large nuclei, but never any chlorophyll granules. The connection between the cells when mature is often very loose, especially between the two layers, which frequently separate from each other upon the rupture of the very delicate membrane which I have occasionally traced enveloping the whole gland. The whole gland in such a case becomes like a much flattened cup, around the mouth of which there collects a quantity of mucilaginous matter in which there may generally be seen embedded animal and plant remains. Each gland is in connection with certain special lines of vascular cells which traverse the tissue of the stem between the axial cylinder and the circumference. See fig. 5, *g. t.*, where these vascular cells are shown in vertical section in connection with the section of the gland (*g*), in the axil of the leaf; and see also fig. 4, *g. t.*, in which horizontal section of the stem eight gland traces are shown. In fig. 2, which represents the growing apex of the stem, denuded of its older leaves, some of the glands may be seen in situ. They attain their full size long before the leaves have done growing, and become brown and very frequently disintegrated, whilst the leaves in whose axils they stand are still healthy and vigorous.

If all the leaves are torn off a young growing piece of Anacharis, the glands will in many cases be left on the stem, and may thence be readily detached for examination; but if it is desired to see them on the base of a leaf, as in fig 3, it is better to scrape or shave the leaves off the stem with a sharp knife.

Taking all the circumstances of position, structure, and relationship to the stem into consideration, I am disposed to attribute to these tiny glands the important function of absorbing nitrogenous matters; and to believe that they are in a measure analogous to the glands of Sundew—or more closely probably to the quadrified processes which line the bladders of Utricularia. Therefore, that they exercise a powerful influence over the life history of Anacharis, furnishing as they do to every node of the plant a set of organs equivalent in certain functions to roots.

The flowers float upon the water and are very small, being only about $\frac{1}{4}$th of an inch in diameter. They are greenish pink in colour, and are produced singly in the axils of the upper leaves. The ovary is small, oval, and enclosed within a two-lipped narrow spathe, above which the long. slender perianth tube rises to a length of from two to eight inches, by not more than $\frac{1}{16}$th of an inch in diameter. This expands on the surface of the water into a flower of six segments, three outer boat shaped and three inner reflexed. There are generally from three to six abortive stamens, some of which may occasionally be found producing anthers and pollen. The pistil consists of a unilocular inferior ovary, developing a few straight ovules on three parietal placentas, a long thin style, adherent to the perianth tube; surmounted by three short obtuse papillose stigmas.

Practically, the plant is diœcious, and until 1880 it was believed that we had only the pistillate plant in Great Britain; but in that year the late Mr. David Douglas found the staminate plant flowering freely in a pond on the Braid Hills, near Edinburgh. This differed very slightly in appearance from the female plant. The place of the staminodes and stigmas was occupied by a central column of six to twelve stamens united by their filaments, but with free anthers; and the perianth tube was longer and even more slender than in the female flowers, ultimately narrowing and breaking off, and so allowing the flower with its supply of stamens and pollen to float freely on the surface of the water. Thus calling at once to mind the mode of fertilization so well known in the allied South European genus *Vallisneria spiralis*.

There is no published account of the perfect fruit or fertile seeds of Anacharis ever having been developed in Great Britain. The obvious inference is, therefore, that all the immense quantities of this plant at present flourishing here have arisen by development of fragments detached from the plant originally introduced.

When we remember that half a century has not yet elapsed since the appearance of the first fully authenticated record of the occurrence of Anacharis in British waters, and then call to mind that at the present time it has extended not only over the British Islands, but also over the greater part of the Continent of Europe,—and further, that in point of mere quantity Anacharis at one time probably nearly equalled in amount all other British aquatic plants put together,—it will be obvious that a problem is here presented in development entirely without parallel in the higher vegetable kingdom.

Originally a native of North American rivers, and there by no means a troublesone weed, it has been from there introduced into Great Britain in some mysterious and quite unknown manner. The conjecture which seems to obtain most favour is that a sprig or seed of Anacharis was unwittingly brought over to this country and placed in our rivers sticking in a crevice in a log of American timber. Once so introduced, it seemingly at once developed those remarkable powers of increase which have since attracted the notice not only of botanists, but of everyone who for any purpose whatever had any interest in the water-courses or ponds of our country. The following chronological account of published references to its first appearance and spread in various districts will probably convey the best idea of what that increase has been:—

	1817	PROF. OLIVER says probably first introduced—no locality or authority given.
	1836	Waringstown, County Down, Ireland—MR. JOHN DEW.
	1866	"Still local in Ireland"—*Cybele Hibernica*.
N. BRITAIN.	1843	Dunse Loch, Dunse Castle, Berwickshire; "In profusion, in Loch only"—DR. JOHNSTON, Berwick-on-Tweed.
	1848	Stream from Dunse Loch, "few tufts."
	1848	River Whiteadder (from above), "abundant."
	1850	"Whiteadder almost choked with it; had to be dredged to free Gainslaw Bridge."
	1850	"Tweed so full of it as to be a serious hindrance to salmon fishers."
	1851	"Dunse Loch entirely free of it—supposed swans had eaten it, as they followed it down to the Whiteadder and Tweed, deserting the Loch entirely"—MISS PRATT.
CENTRAL ENGLAND.	1847	Reservoir adjoining Foxton Locks, in canal near Market Harborough, Leicestershire, "in considerable abundance, matted together"—MISS KIRBY.
	1847	Specimens sent by MISS KIRBY to PROF. BABINGTON, who described and figured it in the "Annals and Magazine of Natural History," in February. 1848.
	1847	River Lene, near Nottingham (tributary of Trent), "1-4th mile mass"—MR. J. MITCHELL.
	1847	Watford Locks, Northampton, "very abundant"—MR. KIRK. Lockman and labourers said had been so for twenty years.
	1849	Trent and Canal, Derbyshire and Staffordshire, "abundant" MR. BROWN.
	1850	Warwickshire, near Rugby, "greatest abundance"—MR. KIRK.
	1851	Trent, Burton-on-Trent, "Bids fair to block up one of the two streams into which the Trent here divides"—REV. W. M. HIND.
RIVER CAM.	1847	Specimen sent from Foxton Lock by MISS KIRBY planted by PROF. BABINGTON in tub in Botanic Garden, Cambridge.
	1848	Specimen from tub planted in the conduit stream by MR. MURRAY, Curator.
	1849	Plant had spread and hidden the stick with which it was marked in the conduit stream.
	1852	"Had spread from conduit stream into River Cam, which it had so completely choked as to raise the water-level several inches; obstructed docks, sluices, water-courses, and drainage; quite prevented fishing, swimming, or rowing, and greatly hindered the towing of barges."
FEN DISTRICT.	1852	First invaded the Fen District, and in a few years so choked up the dykes as to seriously impede drainage by raising the water-levels. MR. RAWLINSON in consequence sent down by Government to advise as to best means to counteract the danger. Dredging out, &c., tried, without avail; and finding all artificial means for eradication of no avail, it was finally decided to try would it after a while diminish in quantity, which it was found to do in a few years. Not now looked upon as a source of danger.

LOCAL NOTES.

1867 Large fishpond in front of Eaton Hall so choked with it as to prevent water-fowl swimming across. Thoroughly dredged out in autumn of same year.

1868 Same pond again full; water now drained off, and bottom thoroughly cleaned.

1870 Stream running through Ball's Knolls Meadows full of it.

1873 Choked out all other vegetation from ditches in Queen's Park Meadows, and ponds in Saltney Fields.

1884 Still frequent in all the above localities, but far less abundant than formerly.

The last observation applies equally to all recorded instances of its occurrence where its natural progress has not been interfered with by attempts at its extermination The experience of those who have had most to do with it seems to indicate that if left alone, its habit is, upon first introduction into a new locality, to spread with alarming rapidity; so much so as literally to choke other water plants out of existence. But this active phase reaches a maximum in from five to seven years, and then gradually declines, until at last the Anacharis ceases to be a pest, and becomes an ordinary denizen of the pond, river, or canal, as the case may be.

Remembering the unisexual nature of the plant, and the peculiarities of its structure, how are we to account for it becoming so enormously abundant here, while it shows no such tendency in its native country? And, further, having once become so abundant, how are we to account for its subsequent diminution? The rapid increase I believe to be due to the following causes:—

a. Our rivers are slower, shallower, and contain more nitrogenous matter than the deeper rapid rivers of America; therefore it finds ample food, and is less often completely cleared away by powerful currents.

b. Our winters are milder, therefore permitting a longer period of growth.

c. Virgin soil (other conditions being favourable), or water, has a well known and notable effect in promoting increased growth.

d. British specimens of Anacharis do not produce seed, which is always an exhaustive process in vegetable life. Plants or even animals hindered from sexual reproduction commonly exhibit abnormal conditions of size and longevity. Annual plants may often be made biennial or even perennial by preventing them from seeding.

e. Every fragment has the power of continuing the life of the plant. The axillary glands probably performing for such fragments the nitrogen absorbing functions commonly performed by roots; enabling the plant to live and grow for lengthened periods without any roots at all.

All these causes influence, but no one of them individually fully accounts for the rapid spread and present abundance of Anacharis; which has also been further aided by the aquatic nature of the plant, and the consequent readiness with which floating vegetative fragments are conveyed over the whole water system of the country; or by adhering to the feet and plumage of water fowl are carried to isolated pieces of water.

Somewhat comparable instances of increased fecundity of introduced plants and animals are frequent. As, for example, the Scotch Thistle, Castor Oil Plant, and common Sparrow, in Australia; *Xanthium spinosum* in South Africa; European Artichokes in South America; the common Asiatic Cockroach in Great Britain; the Norway Rat in our farmyards; *Dreissena polymorpha* in our canals and rivers. But none of these well-known examples are exactly analogous with Anacharis because they are all reproduced sexually, whereas it is invariably increased asexually. And I have sought in vain for any plant or animal wherewith strictly to compare Anacharis as to its peculiar mode of spreading and rate of increase.

As to its decrease, I have no doubt whatever that it is no longer increasing. In many places it continues to grow with unabated vigour; in others it just maintains its ground; in some others it is manifestly less in quantity; and from some ponds, ditches, and streams where it was quite recently abundant, it has now entirely disappeared. Taking it altogether, it appears that its maximum abundance is past, and that it is certainly on the wane in our own district and also elsewhere. This decrease I believe to be chiefly due to a cause which at first is most powerful in promoting its increase, viz., the non-reproduction by seed. Plants which depend for their continuance upon non-sexual reproduction gradually become more and more enfeebled in constitution. They are certainly not so hardy as seedling plants, nor able so vigorously to contend in the struggle for existence. The lengthened cycle of phenomenal activity which is presented to us by Anacharis, has its exact analogue in the much more brief life histories of some of the lower forms of vegetable life; and may not the same reasons apply to the still dimly understood phenomena connected with rapid spread at intervals of disease germs? May they not, under particular conditions, develop a generation with excessively active powers, which shall multiply for a time asexually, until its vigour be in part or completely exhausted, when it either perishes or reverts to its normal comparatively harmless condition, and so remain until the recurrence of certain external conditions shall once more excite it into abnormal activity.

The study and consideration of such phenomena suggests the idea that the vitality of an organism progressively diminishes throughout life; commencing at birth with the maximum, and gradually expending it in the various so-called vital functions, until their entire cessation marks its entire exhaustion, viz.,—death. What we call "life" seems indeed to depend upon the action and reaction upon each other of two distinct particles of protoplasm, endowed with the power of acting upon each other in a manner which may be compared to effervescence. This period of effervescence—life, continues so long as any difference remains either in potentiality, construction, or constitution between the two interacting particles, and may also be greatly prolonged or shortened by external conditions. So soon as they cease to differ, life ceases, and we have death.

Therefore the probability is that unless male plants of Anacharis occur in other parts of the country, or the plants become more truly hemaphrodite, it will continue its eccentric course until it has exhausted its present abnormal vitality, and then either become rare or die out in Great Britain altogether. If the male plant should spread, it will most probably never die out, but its rapid increase will be effectually checked, and its vegetative powers be greatly reduced by the demands made upon its strength incidental to the development of seeds. The old tenants of our waters will then have a better chance to defend themselves in the struggle for existence, and may probably finally oust the invader altogether.

EXPLANATION OF PLATE

ILLUSTRATING J. D. SIDDALL'S PAPER ON "ANACHARIS ALSINASTRUM."

FIG. 1.—*a.* Female plant, reduced $\frac{1}{3}^{\text{rd.}}$

b. Male plant, do. do.

c. Female flower, natural size.

d. Male flower, do. do.

e. Section of ovary, do. do.

f. Leaf, slightly enlarged, two glands at base.

FIG. 2.—Growing point of stem.

g. Axillary glands *in situ.*

FIG. 3.—Axillary gland, enlarged 135 diameters.

FIG. 4.—Transverse section of stem, enlarged 45 diameters.

g.t. Gland trace.

FIG. 5.—Vertical section of stem, enlarged 45 diameters.

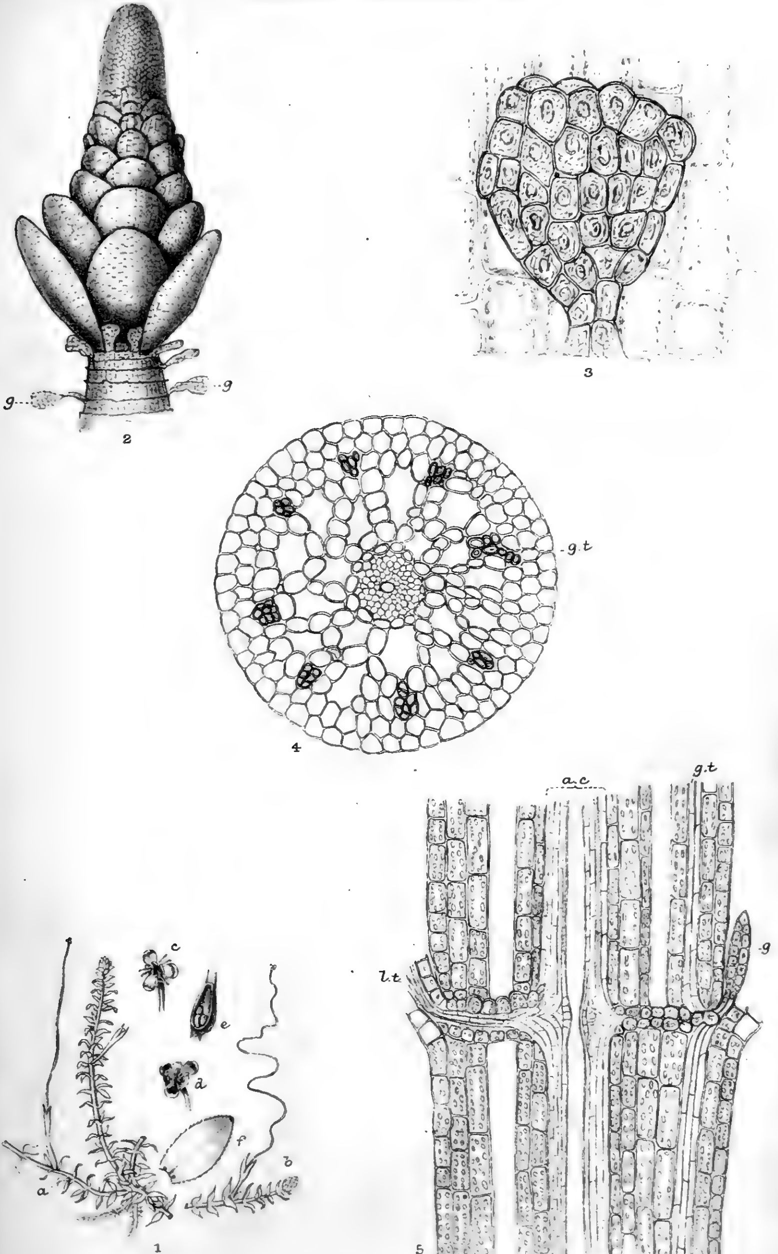
g. Gland.

l.t. Leaf trace.

g.t. Gland trace.

a.c. Axial cylinder.

Anacharis alsinastrum. *Bab.*



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Vegetable Phosphorescence:

COMMUNICATED TO THE CHESTER SOCIETY OF NATURAL SCIENCE
BY THE LATE
J. PRICE, M.A.,
LATE OF ST. JOHN'S, CAMBRIDGE.)

Read December 4th, 1884.

I BELIEVE I may safely say, "'Tis sixty years since" I crossed, in the dead o night, on horseback, the low hills between Tal-y-Cafn Ferry, on the Conwy, and the monastic village of Gwytheryn, in Denbighshire, where St. Winifred was buried. I am not sure the *year* was precisely 1824; but I can have no doubt in naming the *day* as the 11th of August, because the object of that nocturnal flit was to reach the Moors by the dawn of that important day, "The 12th," so as to compete hopefully with shooting parties, only too numerous, in a free district where the grouse were only too few. I was accompanied by a brace of super-excellent pointers, trained after a model rarely attained in these "*driving*" days, and by an odd pair of historical *biped* personages. One was Robert Williams, the Miller of Furnace, who shot that rare bird, the *Squacco Heron*, presented to the British Museum *in his name*, which he had the pleasure of reading there some time afterwards; and, with pardonable exultation, introduced himself and his bird, in pretty good English, to a group of staring visitors! The *other* "bìpès implùmis" was a precocious little cowboy, who developed, under my father's training, a remarkable talent for horticulture, and was long known in Llandudno and Conwy markets as "John Hughes, the Marl Gardener."

My elder aide-de-camp, being ex-gamekeeper at Hafodunos, was well acquainted with every nook and corner of those moors, and with their *boundaries*. He was therefore invaluable to me, in my laudable endeavours to outwit both the feathered tribes and my rivals in the field, without trespassing on adjoining preserves. A curious accident on the way, however, showed that my trusty guide was not absolutely infallible. After we got into what *used* to be, in "the good old times," an open common, we were shortly encountered by sod fences, which were quite new to the Miller, and, the night being dark, fairly puzzled him! He at once boldly extemporized a gap, exclaiming, in peevish Welsh, not easily translated, "What mischief in people, to enclose the mountain in this way!" But this short escape from confinement only led into dangerous ground, and we very soon got "bogged," the horrors of which, with the snorting and plunging of the terrified horses, I can never forget, but will not attempt *here* to describe. Suffice it to say that, but for this disaster (from which we were mercifully extricated without spades and ropes), I think it probable that the phenomenon I am about to recount might have escaped notice.

When we got out on *terra firma* and resumed our march, I was following the other two at some little distance, when I was startled beyond measure by a sight such as I had never witnessed before, and have never seen since; a sight which made ample amends for the wicked enclosure and its alarming sequel. Each of the horses in advance had left behind him a track of fire!! the footprints being exhibited as arches of beautiful silvery light!!! I stopped to gaze at this weird illumination with amazement, perhaps not *quite* unmixed with superstition, for I knew nothing in nature to account for the fact. Calling my companions back, I dismounted to examine their tracks and mine more carefully, and found the light was due to a substance which could be transferred to my hand, and spread out *with increased brilliancy*. On further search, it turned out that the luminosity was not confined to the horsetracks, but was diffused, in sparks and silvery threads, through the peaty soil and amidst the roots of the grass. All these yielded *more light on pressure*, and could be expanded into flaring surfaces by careful manipulation. These results seemed to establish the presence of some phosphorescent material distinct from the peat or grass with which it was mixed. I took some little sods home to Bodnant, and, by keeping them damp, was enabled to show specks of the light for about a fortnight.

To this day I have no better explanation than a conjecture that it was owing to the mycelium of some minute fungus penetrating the soil after the manner of "dry rot." I have read of caves, near Dresden, illuminated by natural chandeliers of pendant Byssus; and the glare of "touchwood," with which many of us are familiar from childhood, is [I presume, indisputably] produced by fungi insinuating themselves between the decayed fibres. These, according to the late Dr. George Cumming, of Chester (a good observer of nature,) *must* always be of ash; but my object in this memoir is to draw forth original observations, and to invite that free discussion which has so often proved the main charm of our meetings. I hope the more fertile subject of *Animal* Phosphorescence will be taken up by the other section.

NOTE.—Mr. Hardy, of Old Cambus (Parish of Cockburnspath,) writes on this subject: "When living at Penmaenshiel, long ago, I used to see it on the cart wheels when crossing *boggy ground* in the autumn, when corn was led from outlying fields that *had once been moor*, and I have taken up handfuls from the soil." Mr. Dick informs us that a log in a wood near Holywell, which he has often passed before and since without seeing any light, was, on one occasion, so brilliant that he thought Gipsies had kindled a fire there. It seems, therefore to be affected by atmospheric conditions, whatever be the source of light.

Observations on the Silurian Rocks of North Wales.

BY T. McKENNY HUGHES, M.A., F.R.S.,
WOODWARDIAN PROFESSOR OF GEOLOGY, CAMBRIDGE.

Read January 8th, 1886.

IN the following Paper I propose to offer to the Society (1) a description of some Sections across the Silurian Rocks of our district, (2) further observations on districts which I have already noticed in communications to the Society, and (3) a tentative correlation of the various horizons indicated with those of other adjoining areas, such as may at any rate suggest lines of enquiry to those interested in palæontological stratigraphy. I have not, however, observed the above order, believing that in communications of this kind it is generally better to reverse the order and to state early the results arrived at, and then discuss the facts and observations upon which the conclusions have been formed.

I shall therefore first give in columns five typical sections; next, comments upon them; and then I shall describe the succession in our district, pointing out what horizon or zone in the northern or southern series each subdivision, from its fossils or stratigraphical position, seems to represent. *(See table on following page.)*

In this table it will be seen that the five sections referred to readily fall into two groups, viz., the southern, of which the types are found in the Counties of Carmarthen and Hereford, and the northern are represented in Denbigh, Westmorland, and Yorkshire. I have not carried the comparison further than what may be called the adjoining areas, but I have not strictly confined my references to the limits of the Counties named.

There is across central England and Wales an axis of more marked movement, resulting in barriers which have affected the stratigraphical structure throughout almost the whole geological series. It separated the northern volcanic region of the Upper Cambrian, or, as it is the fashion now to call it, the Ordovician from their southern equivalents, in which traces of volcanic activity of that age are rare. It is very marked in the Silurian Rocks with which we are now more especially concerned.

A *CARMARTHEN.*	B *HEREFORD.*	C *WESTMORLAND.*	D *YORKSHIRE.*	E *DENBIGH.*
Merthynian or Sawdde Beds	Lower Old Red			
Passage Tilestone Hay Sandstone Ludlow Rocks	Passage Ledbury Shale Downton Sandstone Upper Ludlow Shale Aymestry Limestone Lower Ludlow Shale	Unconformity Kirkby Moor Flags Rest of Kendal Group Bannisdale Slates Firbank Limestones Tebay Mudstones Howgill Beds Acidaspis zone Winder Grit	Unconformity	Unconformity Sandstones (?) Shales N. of Llansannan (?) Grove Mudstones Bodfari Beds Acidaspis Zone
Cae Sara Limestone Wenlock Shale	Wenlock Limestone Wenlock Shale	Helm Knot Sandstone Upper Coniston Flags	Studfold Sandstone Leck Beck Flags (=Arco Wood Flags)	Moelfammau Sandstone Nantglyn Flags
	Woolhope Limestone	Middle Coniston Flags	Austwick Grit	Caer Drewyn Grit
Tarannon Shale Upper May Hill	Eastnor Red Shale	Lower Coniston Flags Pale slates	Austwick Flags Red Shale and Pale Slates	Penyglog Flags Pale Slates
Lower May Hill	Wych Beds			
		Graptolithic Mudstone	Graptolithic Mudstone (Spengill Limestone)	Graptolithic Mudstones
Blaenycwm Conglomerate	Miss Phillips' Conglomerate	Paste Rock or Conglomerate	Zone of Phacops elegans Calcareous Grit or Conglomerate	Pisolitic Limestone and Calcareous Grit or Conglomerate

In the southern area the basement beds are greatly thickened by the development of the May Hill Series, and the uppermost beds pass gradually up into an enormous mass of deposits which have been erroneously included in the Old Red Sandstone. In the northern sections, on the other hand, there is none of this covering deposit of red rocks, nor are the highest beds of the Silurian itself generally to be identified, but the basement bed of the Carboniferous is superposed unconformably and transgressively on all the various members of the Silurian Series. Nor is it only in the incoming and outgoing of the series that this difference between the southern and northern types is seen. In the middle, also, there are the same indications of some difference in the conditions affecting sedimentation, for there are in the southern area well marked limestones occurring at fairly constant horizons which were of course seized upon as convenient for purposes of classification and correlation, though they do not always coincide with the most marked palæontological or other natural divisions. In the northern area, on the other hand, these limestones are absent, or only to be tentatively identified with certain calcareous bands caused by banks of shells which, though ranging above and below, happen to be there so much more numerous as to have given rise to bands of limestone.

In the northern area there are enormous masses of sandstone, generally of very uniform texture. These beds have, to the touch, all the roughness of a coarser rock, and, contrasting strongly with the shales among which they occur, were first spoken of as Grits, as in the case of Denbigh Grit, Coniston Grit, &c., a term which should be reserved for a rock of much larger grain. There are, however, some lenticular beds among them, which may properly be spoken of as Grits, where the grains are as coarse as mustard seed or sweet pea. In the southern area there is very little sandstone or grit. The great thickness of the basement series, the prevalence of finer sediment, and the recurrence of limestones throughout in the southern sections probably point to a more rapid sinking of the sea bottom in that area, so that by the time that the middle and upper part of the deposit had been laid down, shallow water conditions could only prevail where the whole of that part of the sea had been silted up Then, when the sea bottom was within reach of wind waves, and of strong running tidal action, coarse sands would be again carried over the area from a distance, and spread here and there above the thousands of feet of muddy sediment, the deposit of which had kept pace with the depression of the sea bottom.

Perhaps the most convenient mode of laying the matter before the Society will be to describe the characteristics of each section of the table separately.

Section A.

In Carmarthenshire the section seen up the River Sawdde, near Llangadock, gives the best succession for establishing the upper part of the system. The massive red and brown sandstones which form the Carmarthenshire Van rest on the quartz conglomerate of Cwm Sidan, and this I take to be the base of the Devonian of that area. Below the conglomerate come the red shales of the Sawdde, which I hold should be cut off from the Devonian and bracketed with the Silurian. They have, as I believe, no representatives either in Devonshire or in the northern sections C, D, E. For them I have proposed the name Merthynian, from the county where they are best seen. These pass down rapidly into the flaggy sandstones of the top of the Ludlow, which are locally called Tilestones, as in that district they were used for roofing most of the old churches and farms. But from their weight they required too much timber, and therefore slates have now been generally introduced instead of them. They are well seen by the Black Cock old coaching inn, and in many other places along the borders of Carmarthenshire. Below them is a massive sandy rock much used as a building stone and known as Hay Sandstone from a town of that name on the borders of Breconshire. From beneath these sandy upper beds the main mass of shaley Ludlow crops out, and, being of great thickness, forms a considerable feature.

At Cae Sara, near Myddfai, between the Towy Valley and the Black Mountains, a limestone occurs of sufficient importance to be burnt for lime, and this is identified on palæontological evidence with the Wenlock Limestone. Where this limestone is not seen there is nothing to fix the exact boundary between the shale above, which is correlated with the Ludlow, and the shale below, which is referred to the Wenlock. Where, however, a large number of fossils can be obtained *from one bed* there is generally a sufficient difference in the facies to enable us to refer the shale to one or the other.

Between the Wenlock and the May Hill Sandstone there is mostly a series of fine shales of a red or yellowish-grey paste colour, or red passing down into pale shale, and this into dark lead-grey shale. Very few fossils have been recorded from this series in Carmarthenshire. It is well exposed in the Valley between Epynt and the celebrated locality for May Hill fossils, Craigyrwyddon.

The May Hill Sandstone of this area is very fossiliferous. It may be divided roughly into three horizons, the Upper which passes up into the Wenlock Shale and is characterised by *Pentamerus oblongus*; this is well seen at Castell Craig-yr-Wyddon. The Middle which is characterised by the occurrence of *Stricklandinia lens* as well as *Pentamerus oblongus*, and is seen about Pant-y-gaseg, near Llandovery; and the Lower in which *Meristella crassa* occurs with *Stricklandinia lens*, but no *Pentamerus oblongus*. This may be traced from North of Craig-yr-wyddon, S. West, to the Towy, and on the other side of the river to Blaen-y-cwm, where a thin bed of Conglomerate at its base rests on the Bala Beds.

The lower part of this series, to which the name Lower Llandovery was assigned, must certainly be bracketed with the upper part, which was called Upper Llandovery, instead of connecting it with the Upper Bala, and there does not seem to be any reason why the name *May Hill*, originally given to the series by Professor Sedgwick, in 1852, should be superceded by the newer term *Llandovery*.

If we now travel west and examine the Silurian Rocks where they come up again from below all the Merthynian or Lower Old Red, we have an opportunity of seeing how they behave when deposited near a shore of Archæan and Cambrian Rocks. The highest beds are well seen close to Ledbury Station, and a still better section may be examined in the deep railway cutting through the Northern extension of the Malvern Hills, near Knightwick, on the Worcester and Bromyard Line. Without going into details we may point out that in both these sections there is a clear transition from the Silurian up into the Merthynian or Lower Old Red and the fossils of the Ludlow Rocks *Chonetes lata*, *Lingula cornea*, and an elongated variety of the Lingula are found where beds showing Ludlow conditions of sedimentation recur in the lower part of the Ledbury shales. Although there are thin-bedded sandstones, the tilestones of Section A are not found in this district. The Hay Sandstone, however, is represented by the Downton Sandstone, and the Ludlow Shales are distinctly divided into two by a thick limestone characterised by a new *Pentamerus*—P. Knightii; and on the horizon of the Cae Sara Limestone, of Carmarthenshire, the Wenlock Limestone occurs in this Section (B.) The Wenlock Shale is the same in both, but, at its base we find in the Hereford Section another limestone which might well be described as the Lower Wenlock Limestone. This has, however, been named the Woolhope Limestone from the town where it is most developed. On the horizon of the Tarannon Shale there are generally red or pale pasty beds of shale, but we must not assume that these are strictly synchronous as the fossils of this horizon are of very irregular occurrence and point to very rapidly fluctuating conditions. However, at about the right place in Eastnor Park, near where the Gullet Wood Road turns towards the Obelisk, there is a red rock which by its fossils we should bracket with the Upper May Hill Sandstone.

Below this comes the May Hill Sandstone with *Pentamerus oblongus* and *Stricklandinia lens*, occurring together down to the very base at West Malvern and the Wych, but in Gullet Wood having a series of olive-grey fossiliferous sandstones with *Meristella crassa* running down the Gullet, East of the park boundary gate, and much further than is indicated on the geological survey map.

What we learn from a comparison of this horizon in Sections A and B is that the great series of May Hill Sandstones, so largely developed at Llandovery as to have suggested changing the old name from May Hill Sandstone to Llandovery Rocks, is greatly diminished in thickness as it approaches the Malvern pre-Silurian ridge and becomes more variable, as indeed might be expected in basement beds.

A strong conglomerate made up of the underlying rocks and full of characteristic fossils marks the actual base. The blocks of syenite are so welded on to what was probably originally a calcareous matrix that it is difficult sometimes to see the exact line of demarcation, and some interesting reactions not yet explained, but well-worth attention, have taken place between the calcareous sandy mudstone and the felspathic syenitic—pegmatitic or gneissic rock.

Section C.

We will now cross over some 150 miles or so, and examine the Silurian Rocks where they come out in Westmorland and Yorkshire from beneath the Carboniferous and newer rocks of the Counties of Flint, Chester, and Lancaster.

At the top of the Silurian Rocks here we find *no passage* upwards into any overlying series. The basement beds of the Carboniferous Rocks lie transgressively across the edges of all the Silurian Rocks, and rest in places on the Bala or Arenig Series below, as may be seen for miles along the grand precipices of Ingleborough, in the river sections of the Rawthey, near Sedbergh, in the valleys of the Birkbeck and Lune, near Tebay, and in fact all round the Cumbrian pre-Carboniferous island. At the base of the Carboniferous there are irregular pockety patches of red and variegated shales, limestones, sandstones, and conglomerates, which may represent the extreme edge of the Devonian Rocks thinning out on the shore of the gradually submerged pre-Carboniferous land. For land there undoubtedly was over all this area between the deposit of the Silurian and of the Carboniferous Rocks. I measured the edges of the sedimentary rocks which had been cut off before the land went down again, and found that subaerial and marine coast denudation went on to such an extent in that interval that some 27,000 feet of sedimentary rock had been removed in the interval, and this was arrived at by estimating only the thickness of the beds and not the folds, and without taking account of any possible extension of the Merthynian over this area. This is, perhaps, the greatest unconformity which can be measured in all the geological series, and yet only a short distance to the south the base of the upper series or Devonian has so thickened and so much of the beds that succeed the Silurian conformably have been preserved, that it might be and has been doubted whether any break should be drawn through what has erroneously been bracketed together as the Old Red of South Wales and Hereford.

But the flags and sandstones at the top of the Silurian are still left in places as in the district round Kendal, where, on Kirkby Moor, we find the Tilestones with their characteristic species of *Grammysia*, and *Orthonota*, and *Pterinea*, represented by the Kirkby Moor Flags with the same fossils, and the underlying Hay and Downton Sandstones represented by the Grey Sandstones of the Kendal Group, so well exposed on Benson Knot, with the characteristic *Holopellas*, *&c.*, occurring in brown weathered bands exactly as in the Southern Sections of Carmarthenshire (A.) Below this series we have in Section C some 2,000 feet or so of dark blue flags, shales, or slates, known as the Bannisdale Slate with few fossils but those common to the Ludlow. Then, as seen on the slope of the hill near Firbank and across the hill side to the Sedbergh and Kendal Road, there is a mass of dark grey sandy shale some 800 or 900 feet in thickness, having calcareous bands, especially at the base and top of the series. Those which I have called Firbank Limestones are crowded with, and in fact in places almost made up of *Rhynchonella nucula and R. navicula*, and much resemble the Aymestry Limestone of Knell Coppice, near Malvern. Below this horizon come the beds which I have named the Tebay Mudstones, from the well-known Railway Junction, close to which they are well developed. These last have yielded as yet but one *Orthis*, and that referred by DAVIDSON to a new species. Below the Tebay Mudstones are massive Sandstones, which, repeated by many a fold and fault, form the bold outlines of the Howgill Fells. The fossils of this series have been given in the Mem. Geol. Survey, 98 N.E., and hardly justify our separating the series from the Ludlow Rocks, especially when we take account of the Winder Grit Colony in the lower part of the series, immediately north of Sedbergh, in which the *fossils found together in the same bed* have a decided Ludlow facies, and on the west of Helm Knot a thin bed of pea-grit with the same fossils occurs among the lower beds of the sandstone. At a slightly higher horizon, on the Riggs between Helm Knot and Sedbergh, and at High Hollins, as well as at the south end of Casterton Low Fell, there is a fossiliferous band of great importance for our present purpose. It is characterized by a new species of *Acidaspis* which SALTER has called *A. Hughesii.* This bed is confined to one very limited horizon. Its lithological character is not very marked, but yet sufficiently distinctive to help one in selecting the rock best worth searching for fossils. It is a dark grey sandy mudstone breaking into short prismatic fragments, and frequently showing a ball and socket arrangement such as might result from an incipient conchoidal fracture, helped perhaps sometimes by a slight concretionary structure (see Mem. Geol. Survey, 98 S.E., p. 10; 98 N.E., p. 11.)

The base of this sandy series is sometimes, as on Helm Knot, very fossiliferous, and passes down gradually into the thick flags known as the Coniston Flags. All the Sandy Series, from the top of the Tebay Mudstones to the base of the Helm Knot Sandstones, being known as the Coniston Grit.

At the base of the Coniston Flags in the Lake District, there is a very variable series consisting of red shales, pale paste-coloured rock, and black bituminous shales, so full of graptolites, as to have been named by Professors HARKNESS and NICHOLSON, who first observed them, the Graptolithic Mudstones.* At the base of the Graptolithic Mudstones, there is often a strong conglomerate. In the typical Sections behind the Low Wood Hotel, on Windermere, this can hardly be called a conglomerate, but in the tributaries of the Rawthey, above Sedbergh, the conglomerate is well developed. In the S.W. corner of the Howgill Fells, near Ravenstonedale, there is a valley called Westerdale, in which, at the junction of Spengill and Stockless Gill, a very instructive section through the basement beds is exposed. The lower Coniston Flags, with *Monograptus priodon*, pass rapidly down into red flaggy shale, and this into blocky grey and red mudstone, which with the interruption of some crushed rock and an intruded felspathic mass, passes down into banded and striped pale paste-coloured rock with darker or lighter grey shaley partings. At this horizon there are sandy beds and thin lenticular bands of limestone with fossils distinct from those in the beds above or below. Underneath these are some 210 feet of shales breaking up into prismatic fragments, and having at their base a calcareous gritty band with *Meristella crassa, &c.* Here we have the May Hill basement series with its characteristic fossils, and above it the Graptolithic Mudstones, many of the various zones in which have been identified by the graptolites, and correlated with those of Scotland; and above these again, the Pale Slates passing up into the Lower Coniston Flags (Austwick Flags.)

In the calcareous gritty basement bed the following fossils occur:—

Favosites fibrosa
Strophomena ungula (?)
Orthis hirnantensis
O. protensa
O. crispa (?)
O. sp., a turgid form
Pentamerus liratus (?)
Meristella crassa

This bed occurs exactly where the mountain path crosses the stream, and must not be confounded with another somewhat similar gritty bed a little lower down the stream in the Bala Series.

In this section the conglomerate of the Sedbergh basement beds is hardly represented, but the *Meristella* is common to the lower beds in both areas. On Windermere there is only a thin pasty band at the base of the Graptolithic Mudstones, resting on the Coniston Limestone Series; but at Ashgill, near

* The true equivalency of the sub-divisions of the lower part of the Silurian of the Lake District has more recently been worked out by MR. MARR. *Geol. Mag.*, 1887, p. 35.

Coniston, there are higher shales (Ashgill Shales) of the underlying series remaining and the basement bed is represented by a thin calcareous band.

Above the basement beds the Graptolithic Mudstones, Pale Shales, and various sub-divisions of the Coniston Flags come on, and though all the Graptolite zones cannot everywhere be detected, that is probably in most cases owing to obscured sections or insufficient time devoted to the search, seeing that, when found, their order of succession is constant. Also the lenticular limestones at the base and the sandy horizons in the lower part of the Coniston Flags are not, from the nature of the case, to be expected in every section.

Section D.

In the Craven District there is still much variation among the basement beds, but a great similarity when we examine the higher members of the Series. I will take as my type the section seen up Austwick Beck. The Carboniferous Rocks with pockety patches representing the Devonian can here be seen resting almost horizontally on the up-turned edges of the Silurian and Upper Cambrian (Ordovician) Rocks. It is one of the most marked and most remarkable unconformities in the world. The uppermost beds of the Silurian are nowhere seen in this area. The highest that has escaped denudation is the Studfold Sandstone, quarried near a farm of that name, east of the Ribble between Settle and Horton. This is seen to rest on the flags of Arco Wood, the equivalent of the Leck Beck Flags and of the upper or main mass of the Coniston Flags. A massive unfossiliferous grit, which I have described as the Austwick Grit, separates these from the Austwick Flags below which pass down into red shale and these into pale slates in the lower part of which the zones of the Graptolithic Mudstone are represented, but here we find a band of Limestone in which Mr. Marr detected the characteristic *Phacops elegans*, and at the base of this clear and variable series there is a strong conglomerate separating the basement beds of the Silurian from the Bala Shales and Limestones.

There is another important section a few miles further up the valley where a fold brings up the Coniston Limestone, and the basement bed of the Silurian rests directly on it without the intervention of the *Trinucleus* and *Strophomena* Shales. The basement bed here itself consists of a brecciated concretionary limestone with a different group of fossils from that in the underlying Coniston Limestone. Here we have the same kind of difficulty as we shall see arises at Aberhirnant.

Section E.

Now we are in a position to examine the Sections of North Wales, with a knowledge of the sequence in the adjoining areas, and we find that all the characters we observe in our own District have their counterpart in the others. The horizons which are most variable here, have the greatest number of different developments elsewhere, and the somewhat isolated fossiliferous zones, though not to be all exactly found in any one of the other sections quoted, can be identified *in one or other of them*, so that a fair probability is presented that we have a true sequence.

In our District, as in the north of England, the beds which conformably succeed the Silurian are nowhere represented, nor are there any beds lithologically or palæontologically like the Kirkby Moor Flags of the north, or the Tilestones of the south. Indeed, it is very doubtful, whether we have left *in situ* any equivalent of the Benson Knot beds, or of the Downton Sandstone But here comes in the difficulty, that almost all the species, which by the concurrence of a very large number of individuals, give a distinctive character to the massive sandstones of the Upper Ludlow, do occur sporadically through both Coniston and Denbigh Grit Series; and in one case in the north of England, where suitable conditions prevailed, are found in the very same association low down in the Coniston Grit (see p. 147), so that this anticipation of Ludlow, or antitype of a colony, should teach us caution in inferring that we must be high up in the series because of the appearance of a group of the forms which are generally individually more numerous in the Upper Ludlow.

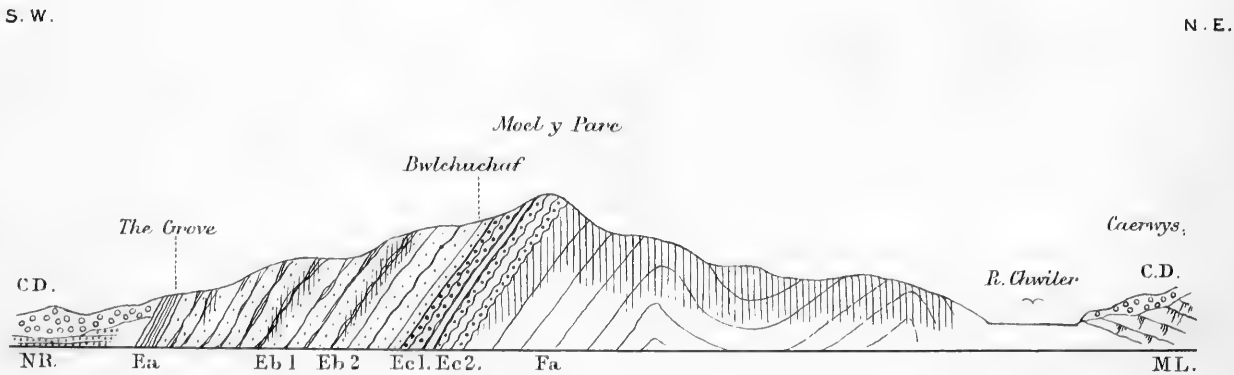
Below these sandstones, however, our review of surrounding areas leads us to look for very thick beds of shale with a tendency to become flaggy. Shales represent the finer sediment which has been carried far away from its source, and has been allowed to settle down out of reach of constantly shifting currents, generally in deeper water and further from land We may expect, therefore, to find that the great shales are of wider extent and of greater constancy of occurrence at the same horizon, than any of the basement deposits, or even than the grits and sandstones which occur higher up in the series. But where the depression has ceased, or at any rate no longer keeps pace with the denudation of the nearest land, and the consequent deposition in the adjoining sea, there the whole basin must be silted up, and, shallow water again prevailing, currents will carry coarser sediment over the area. Thus, we may expect to find sandy sediment in the highest beds which creep out from below the unconformable Mountain Limestone, with its basement conglomerate, near Llysfaen, and other places along the North Wales borders.

Salter was of opinion that in the Llansannan Shales we had beds higher in the series than the main-mass of the Denbigh Grits. I am not in a position to confirm this view, but have great suspicions that the Llansannan Shale passes under the

SECTION I.

SECTION ACROSS THE CLWYDIAN RANGE
SOUTH OF MOEL Y PARC, BODFARI.

Length of Section 2½ miles.



Mintern Bros. lith.

fossiliferous calcareous beds of Pontyralltgoch, which I would refer to a much lower horizon than the top of the Denbigh Grit. My object in this communication is not however to attempt to draw a map of the Silurian of our District, but to offer some more traverses along which, I think, I have established the sequence, and where I am able to offer a correlation in which may be found some useful base lines for those who have time and opportunity to pursue the investigation, and the section I particularly wish to illustrate is that across the Clwydian Range nearest to Chester.

FIG. 1.

At the North-east end of the Section is the sand and gravel of the Clwydian Drift (C.D.) resting on Mountain Limestone (M.L.) On the South-west of the River Chwiler the Nantglyn Flags are turned sharply over into the valley as if near a fault.

F.a. Represents the Nantglyn Flags which, under the N.E. flank of Moel-y-parc, consist of blue mudstone, weathering yellow, with the cleavage constantly vertical across undulating beds, and splitting into slabs about ½ inch thick. These are well-seen between Nannerch and Moel Arthur.

Ec. 2. Thin beds of grey tough sandstone with more shaley partings and lines of gingerbread coloured rotten stone with fossils.

Ec. 1. Finely but irregularly laminated sandy shale becoming flaggy.

Eb. 2. Flaggy, dark and light-grey sandstones, with tracks and Graptolites. There are some very massive beds, and some curious, crinkly, or knobbly surfaces, like those seen on slag or lava, and due to concretionary action accompanying pressure-moulding of the rock. These beds are well seen West of Moel Arthur.

Eb. 1. Light-grey concretionary sandstones with bands of rotten stone full of casts of fossils.

E.a. More flaggy beds of grey sandstone.

Clwydian Drift (C.D.) lying irregularly on New Red (N.R.)

The highest beds of which I have any knowledge in that district are the sandy mudstones seen in quarries and numerous out-crops close to the Grove, east of Bodfari. The place of these beds in the section is fairly clear. They pass down into the shales, mudstones, and tough sandstones, which occupy all the western slope of Moel-y-parc. They consist of dark lead-grey sandy mudstones in which the iron is here and there oxidized so as to give a rusty appearance to the rock. Fossils are numerous in certain bands, and from them I have obtained the following species:—

Favosites fibrosa
Atrypa reticularis
Orthis elegantula
Rhynchonella nucula
Spirifera elevata
Strophomena rhomboidalis
Pterinea retroflexa
Holopella
Bellerophon
Orthoceras

This list does not prove anything with certainty, but the stratigraphy of the whole district suggests the correlation of these beds with the Tebay Mudstones.

The Grove Shale (*E.a*) passes down into (*Eb.*) the Bodfari Sandstone, which consists of sandy mudstone with many bands and thick masses of tough grey sandstone, which have resisted denudation better than the softer mudstones, and, therefore, standing out prominently all over the ground, give the impression that they form a larger proportion of the rocks of the area than they really do; just as we have already observed was the case with the Coniston Grits. These also are fossiliferous along certain bands. From the tough sandstone fossils are rarely obtained, except where they are calcareous, evidence of which is generally seen in bands of brown or gingerbread coloured crumbling rock, the insoluble residuum when the lime has been dissolved away.

From this subdivision I have obtained the following species:—

Orthis elegantula	*Alveolites*
Rhynchonella nucula	*Crinoid stems*
Meristella sp.	

It is clearly the equivalent of the series of sandstones which, on the other side of the valley, occupy all the higher ground between Dolhyfryd, near Denbigh, and Bryneirin, on the way to Nantglyn.

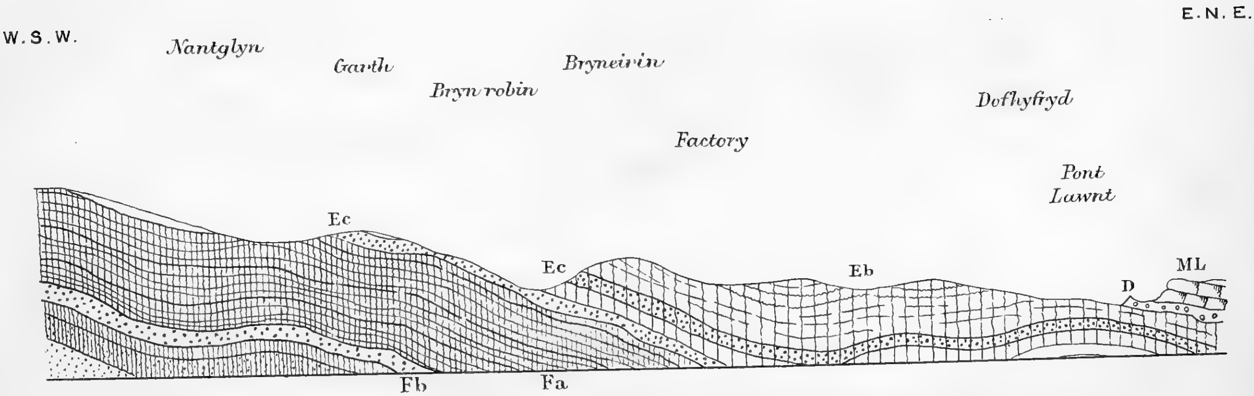
The Moel Fammau Sandstones (*Ec.* 2.) form the summit of the hill, dipping steadily towards the vale on the west. They are but the base of the great sandstone series, known as Denbigh Grits, and here hardly call for separation from the overlying sandstones. But having regard to the constancy of the occurrence of coarser material at this horizon, and in view of the marked feature to which they give rise all along the crest of the Clwydian Range from Moel Fammau to Moel-y-Parc, it will be convenient to consider them separately.

In the Westmorland and Yorkshire area it will be remembered (see pp. 142, 147) that bands of coarse grit and highly fossiliferous beds of sandstone occurred just where we had evidence that the conditions which resulted in the deposition of the Coniston Flags had passed away, and those which produced the massive sandstones of the Coniston Grit Series were coming on.

Encrinite (*Cyathocrinus*) stems are not uncommon in (*Ec.*), but other fossils are rare. On Moel-y-Parc, I have found *Orthoceras gregarium* and *Monograptus colonus*, and on Moel Ganol, *Monticulipora*.

This lowest sandstone has generally above it a flaggy stage (*Ec.* 1.), as may be seen near Bwlchuchaf, and in the quarry about a mile S.S.E. of Moel-y-Parc, near Bodfari. To about this horizon, also, I refer the fossiliferous flags near Segrwyd, about a mile S.W of Denbigh, which have been so well worked by Mr. Luxmoore, and also the thin bedded sandstones of Bryneirin. This is a very important horizon

SECTION II.



ML. Mountain Limestone. D. Devonian or Basement Bed of Carboniferous.

Mintern Bros. lith.

stratigraphically and palæontologically, and I look forward to its proving of great value in tracing out the subdivisions of the Silurian Rocks.

They form the lower stages of a great sandy series (*E.*) which extends along the west flank of the Clwydian Range, and occupies large and as yet undefined areas between the valleys of the Clwyd and Conwy.

From beneath the Moel-y-Parc Sandstones, the Nantglyn Flags (*F.* 1.) rise on the east, and rolling over in two large anticlinals, disappear under the basement beds of the Carboniferous Limestone of Caerwys.

They are the equivalents of the flags of Arco Wood, and of Leek Beck (see pp. 142, 149), and have yielded the following fossils :—

Orthoceras primævum	*Favosites fibrosa*
O. subundulatum	*Cardiola (?)*

Section No. 1 shows the relative position of the beds above described.

Crossing now to the West side of the Vale, near Denbigh, and following the section from Denbigh S.S.W. to Nantglyn, we find the tougher and more massive beds giving rise to prominent features over a considerable area. These upper sandstones and mudstones are here and there fossiliferous and are obviously the equivalents of the Bodfari Beds (*Eb.*) of the East side of the Vale.

Mudstones like those of the Grove overlie, a little off the line of section, the alterations of shale and tough sandstone which roll over and over between Segrwyd and Brynrobin. I will not now discuss the position of the Llansannan Shale, or of the Pontyralltgoch fossiliferous Mudstone, or of the Sandstones south-west of Abergele.

The following diagram shows the relation of the various beds to one another :—

SECTION II.

In this Section the Sandy Beds which roll over between Bryneirin, 2½ miles S.W. of Denbigh and Dolhyfryd, are obviously on the horizon of the Bodfari Beds (*Eb.*) I have found the following fossils at Bryneirin :—

Rhynchonella navicula	*Meristella*
R. nucula	*Strophomena depressa*
Orthis elegantula var sulcata	*Cardiola interrupta*
O. sp. (small coarser form with straight ribs)	*Ctenodonta*
	Orthoceras
O. sp. (small form with ribs bifurcated)	*Monticulipora*
	Encrinite stems

And at Dolhyfryd I have found—

Rhynchonella navicula	*Cyclonema*
Orthis elegantula	*Orthoceras* (a smooth form like *O primævum.*)
Meristella	
Cardiola interrupta	

In the lower part of this series I have identified a very important horizon. In the bed of the stream at Pont Lawnt, there is a fossiliferous mudstone, in which I found the very same *Acidaspis* which occurs in the lower part of the Coniston Grit on Casterton Low Fells (see pp. 142, 147), and which I have detected at the same horizon in various other localities on the south-east borders of Westmorland. With it were associated a very similar group of fossils to those found in the corresponding beds in the North of England.

At Pont Lawnt I found—

Rhynchonella navicula
R. nucula
Cardiola interrupta
Pterinæa tenuistriata
P. subfalcata
Acidaspis Hughesii
Orthoceras primævum

Under these sandstones and mudstones (*Eb.*), with the *Acidaspis* zone near their base, coarser beds corresponding to the Moel Fammau Sandstones (*Ec.*), are thrown into view here and there in the adjoining area by the irregular undulation of the strata, and finally rise into prominence near Brynrobin, capping the hill at Garth. They consist of grey sandstones (*Ec.*) with a concretionary structure owing to which they show wavy white lines or small lenticular whitish beds, or sometimes even spheroidal masses with a rough concentric arrangement of white and grey. The sandstones of Moel Ganol are a good example, as also those of Moel Gasydd, 3 miles S.W. of Denbigh. This is the sandstone which runs along the crest of the Clwydian ridge from Moelyparc, near Bodfari, in the N., to nearly opposite Ruthin, in the S.

The Nantglyn Flags (*Fa.*) form a fairly homogeneous series, splitting into flags where the cleavage is weak or nearly coincident with the bedding; but, where this is not the case, breaking up into striped rab or shiver, or irregular blocks and slabs, or sometimes splitting into slates. It is only here and there that quarries are opened in it for flags or slates, and so the great thickness and extent of the series has been somewhat lost sight of. I take as a typical section that exposed along the hill sides and in the valleys near Nantglyn where the flags have been extensively worked for a very long time.

In the gorge of the Clwyd the flaggy beds, which succeed the sandstones below Meiarth and extend by Derwen, pass under the rough sandstones of Moel-y-Gasedd on the one hand and of Garth and Brynrobin on the other. I think we must refer to this series the dark grey sandy flags which extend up the Clywedog valley to beyond Cyfylliog where they pass under the grey concretionary sandstones of Moel Ganol (*Ec.*) *

* See Q.J.G.S., Vol. xxxv., Nov., 1879, p. 695.

On the East of the Vale of Clwyd the flags which occur along the hill side S. of Caerwys belong, as we have seen, to this series, passing under the tough grey sandstones of Moel-y-parc. Near Conway they are just seen succeeding the grit at the south end of the estuary.

From the Nantglyn Flags, near Nantglyn, I have obtained—

Monograptus vomerinus	*Orthoceras primævum*
Actinocrinus pulcher	

Now we arrive at what from the constancy of its occurrence is a very important stage in the Silurian Rocks of the Northern type. A coarse grit (*Fb.*) generally somewhat calcareous and full of fossils immediately underlies the Nantglyn Flags. It is seen just above the Penyglog Quarry, near Corwen, and indeed, gives the upper limit to the workings. It occurs again on the other side of the Dee on Caer Drewyn maintaining its coarse character. Further north it is represented by the tough grey gritty beds of Garwfynydd, and by the sandstones, partly faulted out of sight, in the gorge of the Clwyd, near Meiarth. South of Conway it is seen in the cliff below Benarth, and projects in ridges out towards the estuary. Here it resumes its coarse character and exactly resembles the grit at Caer Drewyn and Penyglog.

These coarse grits show that some very important change in the conditions of sedimentation had occurred but, as the bed is only a few feet in thickness, we should not infer that it was of long duration, though it affected a very wide area. I am not able to point out any equivalent in the Southern Sections A & B, but in the Northern Section D it seems to be represented by the Austwick Grit which separates the flags into an upper and a lower division. The flags of Leck Beck and Arco Wood above corresponding to the Nantglyn Flags, and the Austwick Flags below agreeing with the Penyglog Flags In the Lake country Mr. AVELINE has traced some gritty bands about this horizon almost across the whole district.

The next division in descending order (*Fc.*) consists of bluish-black flags often finely ribboned with white lines showing the original lamination. This is a bed of very constant occurrence and uniform character. It is the rock in which the great flag and slate quarries of Penyglog occur, and it runs, interrupted by some faults, behind the town of Corwen on the East. The flag quarry N.E. of the church is in Bala Beds faulted up. The Series is seen also in the gorge of the Clwyd between Glynbach and Meiarth where it contains a number of thin subordinate beds of sandstone (o, o′ of Section, Fig. 2., Q.J.G.S., Vol. xxxv., Nov., 1879, p. 697.) It turns up along the Conway estuary forming the cliff for about a mile from opposite the Castle to below Benarth.

From the Penyglog Flags (*Fc.*) the following fossils have been recorded:—

Monograptus priodon, Penyglog, N. of Bryngorlan
Cyrtograptus Murchisoni, Penyglog
Retiolites geinitzianus, Penyglog
Orthoceras primævum, Penyglog
O. subundulatum, Penyglog
Holopella gregaria, Palé, (Ruddy)
Acroculia haliotis, Penyglog (Marr)
Rhynchonella, Palé (Ruddy)
Illænus sp., Clegyrmawr.

These lower flags (*Fc.*) pass down into red or pale pasty rock commonly spoken of as the Tarannon Shale or Pale Slates which are rarely fossiliferous; and these in turn are split up by bands of black shale sometimes full of graptolites, which occur in zones corresponding to those of Westmorland and Yorkshire. In the gorge of the Clwyd for instance, near Clegyrmawr, there are black shales at the bottom of the Pale Slates from which the following fossils have been determined by Mr. MARR:—

Monograptus convolutus
M. triangularis
M. tenuis
M. sp. tike colonus

As is usual, in the case of basement beds, the lowest part of the Silurian of North Wales is very variable. At Corwen, it consists of irregular beds of sandstone, often coarse; sometimes, as in Nant-caweddau, containing pebbles as large as pigeons' eggs. At one place it is made up of somewhat even-bedded sandstones with shaley partings; at another, it is concretionary and irregular; while close by it consists of a thick mass of grey or whitish tough gritty sandstone, with few divisional planes, and often no indication of bedding. Many of these characters may be seen behind the town of Corwen, from which I have named the more sandy development of the series—the Corwen Grits. In that neighbourhood they are seen to pass under the great mass of flags and sandstones of the Berwyns.—Q.J.G.S., Vol. xxxiii., May, 1877, p. 207. Notes—Geol. Vale of Clwyd, Proc. Chester Nat. Sci. Soc., p. 8.

A few miles to the W. the Clwyd cuts through the same series. Under Dinas we find similar sandstones, but here there are bands of pale slate and black mudstone with graptolites intercalated in the upper part of the sandy deposits.

The gritty sandstones of Bod Renail, still further W., are probably on the same horizon; and the series is represented by grey sandstone, succeeded by pale slaty beds, which is exposed on the northern slopes of the great mountain barrier which divides the Dee Valley from the Vale of Clwyd.

The basement series disappears under the great rolling mass of "Denbigh Grits and Flags," which covers North Wales up to the Conway Valley. Here we should look for the basement beds about the position of Conway Castle, and the Castle is built upon a gritty sandstone very similar in character to the

Corwen Grits, but I have not been able to identify them with any certainty as I obtained from those beds only an Orthis and a few other indeterminable fragments of fossils. I know, however, that there are in that district several bands of sandstone in the Bala Beds which might easily be confounded with the Corwen Grit, especially when somewhat decomposed. A little creek cuts off the Castle from the hill on the South, along the estuary at the base of which there is a cliff which shows the succession of the lower part of the Silurian Rocks very clearly. The most northern part, under the hedge by the timberyard, may, perhaps, be more conveniently bracketed with the basement series. (*Ga. & Gb.*)

The Series, though varying in details, is identical in general character. It consists of conglomerate, grit, sandstone, pale felspathic shaley mudstone, and black bands with graptolites. Sometimes the black bands with graptolites were absent; sometimes the pale slates; sometimes the conglomerate; while in other districts it was the sandstone that was most rarely present.

When all are present the order is :—

Ga. Pale slates passing down into
Gb. Black shales with graptolites.
Gc. Sandstone, grit, and conglomerate;

and if we turn to the details of C & D we shall find that each character is exactly represented in one or other of the North of England Sections.

The basement beds can be traced at intervals from Corwen by the shooting box, known as Liberty Hall, under Moelygwynt, where pale slates are seen dipping 10° N.N.E. with a cleavage 65° N.N.W. The Caer Drewyn Grits form further to the East a feature which can be followed from Penyglog to Moel Ferna, and is probably represented by the grit running along the hill about ¼-mile North of Llansantffraid-glynceiriog. South of that place the basement beds are again seen, as I have pointed out on a former occasion (Q.J.G.S 1877, pp 210, 211) running along the line of the tramway near Ponthafodgynfor, and then S.W. up Fronfrys towards Tynyfron. The basement beds are here somewhat irregular and variable, consisting generally of alternations of bands of limestone and fine sandstones with wavy lines of bedding at the base. The calcareous portions weather into a brownish or gingerbread coloured rock, as in the case of the Hirnant Limestone and other calcareous beds of this age; as for instance in Westerdale in Yorkshire (see p. 148.) It must be borne in mind that these basement beds are sometimes very full of pyrites, the decomposition of which helps to produce the rusty appearance so common in the weathered rocks at this horizon.

It will be obvious from a comparison of the two series that the correspondence between the subdivisions in the Lake District and North Wales is too close to be referred to accident.

This, which I have called the syntelism of the rocks, viz., the agreement of the sequence in one district with that in another, is strong evidence, and the fossil evidence, as far as it goes, confirms these identifications

Gc. In the base of the Corwen Grit, near Corwen, I found—

Orihis sp.	*Favosites alveolaris*
Petraia sp.	

From the same horizon (*Gc.*) near Penycae on the S. side of Cyrnybrain:—

Petraia subduplicata	*Meristella crassa*
P. crenulata	

From Plasuchaf:—

Petraia subduplicata	*Orthis protensa*
P. crenulata	*Meristella crassa*

From Ponthafodcynfor and S.E. of Llansaintffraid:—

Favosites alveolaris	*Orthis elegantula*
F. fibrosa	*O. hirnantensis*
Heliolites interstinctus	*O. lata*
Monticulipora lens	*Strophomena rhomboidalis*
Petraia crenulata	*Cyclonema ?*
Glyptocrinus sp.	*Holopella obsoleta*
Tentaculites anglicus	*Macrocheilus fusiformis*
Calymene blumenbachii	*Murchisonia carinata*
Berenicea heterogyra	*M. angulata*
Glauconome disticha	*Platyschisma* or *Rhaphistoma*
Pletodictya costellata or *fucoides*	*Bellerophon*
Leptæna transversalis	*Conularia sowerbyi*
Orthis calligramma	*Orthoceras*

The basement bed (*G.*) in this district is sometimes merely a sandstone, sometimes it is a grit, or even a conglomerate, and sometimes it is a limestone, while often it looks like a bed from which calcareous matter has been removed, leaving only the finer insoluble residuum now in the form of a white pasty mudstone. The occasional presence of such corals as *F. alveolaris* would be enough to suggest that it might sometimes contain a sufficient number of calcareous organisms to form a band of limestone. I have elsewhere given a description of some sections in which it is well seen*.

I will now add a note on the Hirnant Section. It seems to me that there have been two entirely distinct beds confounded under the name Hirnant Limestone. There is a pale grey imperfectly cleaved fine textured clay rock, with numerous nodules of limestone, and containing Bala fossils such as *Orthis actoniæ*, *O. sagittifera*, and *Echinosphærites balthicus*, and that on this rests a crystalline, often pisolitic impure limestone, the zone of *Orthis hirnantensis*, which readily weathers into the dark gingerbread coloured rock in which fossils are fairly abundant, and from the weathered parts of which the casts can be easily procured; and that exactly the same varieties are observed at the same horizon in the Lake District (see p. 149) and, though less distinctly, in South Wales.

* Q.J.G.S., Vol. xxxiii., p. 207. Ruddy, Q.J.G.S., Vol. xxxv., p. 200.

The shell I have referred to as *Meristella crassa* in these lists seems to be absolutely confined to the basement bed. What I would suggest a doubt about is the identification of this clean-cut form with the coarser and more irregular undulating casts seen so commonly at Cefn Rhyddan for instance, near Llandovery.

The northern variety occurs at Llandovery, but I have not found the rougher Llandovery variety in the north. Yet it does not seem likely that we have here a species more allied to *M. augustifrons*, or the still higher *M. tumida*. This is a point of considerable importance in stratigraphy, and I would invite the attention of specialists to it.

Another troublesome shell is *Orthis biforata* which seems to run through from Bala to May Hill. Some occurrences, in Silurian, recorded on the evidence of fragments, turned out to be founded on *O. insularis*; some probably on *Rhynchonella*. This shell requires re-examination—especially as we hardly ever find more than a cast, and collectors are not careful enough about preserving both the outside and inside cast of the *very same specimen*.

Then we have doubtful forms in *Orthis hirnantensis* from the basement beds which it is hard to distinguish in bad specimens from *Strophomena siluriana*, an Upper Bala fossil. In like manner imperfect specimens of *Orthis spiriferoides* of the Bala may suggest the occurrence of *Orthis biforata*.

The characteristic fossil of the Silurian Rocks is *Cardiola interrupta*. As far as I know it runs through the whole system from the Ludlow Rocks to the bottom of the Denbigh and Coniston Flags. It is common in the uppermost beds, and I have found it in the Sedbergh District at the very base of the flags. Moreover, it has not yet been found above or below the Silurian. The statement of BARRANDE that it occurred in the Bala Series in this country was founded on an error. It is abundant in the Coniston Grits, which were at one time supposed by MURCHISON and others to be the equivalent of the Caradoc Sandstone. Therefore, *Cardiola interrupta* got into the lists of Caradoc Sandstone Fossils. When, however, this mistake was corrected and the Coniston Grits were shown to be of Silurian age, the necessary correction was not made in the fossil lists, and *Cardiola interrupta* was left in the list of Caradoc Fossils from which BARRANDE took it.

From various horizons in the Graptolithic Mudstones of North Wales it is very rare to find any fossils but Graptolites. I have, however, frequently found *Lingula brevis* in them in Spengill, and in the Sedbergh district; and in the Spengill Limestone (see pp. 142, 148) there is a small species allied to *Leptæna quinquecostata*, perhaps only a young form. We should look out for these in North Wales.

It would also appear desirable to ask palæontologists to give us a clearer definition of the forms of *Favosites* which we refer to under the specific names, *aspera*, *alveolaris*, and *multipora;* and to reconcile or correct the discrepancies in the descriptions of these species given by different authors It will probably be found that the common form in our basement bed can be distinguished from those which range far down into the underlying series.

What I have endeavoured to bring out in the foregoing sketch is, that there is a sequence of rocks in North Wales to be made out by an examination of a large number of sections which finds a strict parallel in the North of England, and can be in more general terms compared with the Silurian in South Wales That there are certain lithological and palæontological zones at which the correlation is exact, suggesting that what is found in other areas between those horizons may be profitably sought for. [I have not collated all the valuable work in the details of the series chiefly referred to which has been done by others since the reading of this paper, but offer it as a contribution in the same direction, hoping that it may be found useful in aid of future work.]

Caves and Cave Deposits.

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IF any one were to tell us that in an old house which had been a place of some note many centuries ago there had just been discovered a cupboard which was locked up and concealed by a mass of fallen masonry—that it was in one of the principal rooms of the house, and would very likely contain all sorts of queer things which were used by the people who inhabited the house, I think there are very few of us who would not try to run over when they forced the cupboard open and see for ourselves what was there. There is a positive pleasure to be derived from what is called "satisfying one's curiosity," but then we mean "gratifying one's love of knowledge." Love of knowledge we allow is a good thing—a feeling to be cultivated—without holding that the knowledge must produce some practical beneficial results. Curiosity, on the other hand, is held to be a habit of mind not to be indulged, though no use may be made of the information gained to the detriment of any one else. What, then, is the difference between the bad feeling which we include under the head of "curiosity," and the good feeling which we call "love of knowledge?" Is it that curiosity is love of knowledge of things that don't concern us? Not quite. For what we all recognize as a justifiable love of knowledge leads men often to inquire into abstruse or strange questions, the immediate bearing of which on anything else is not apparent. They do not yet know whether it concerns them or not. Curiosity, in a bad sense, is the selfish prying into secrets which it would give pain to another that we should know. But that is very different from the enquiring turn of mind which leads us to be interested in new facts, and in finding out the reason why for everything. I have very little sympathy with those who say to children, "don't be inquisitive, don't be curious." Curiosity or inquisitiveness are in themselves right, and only become wrong when indulged without consideration for the feelings of others. The habits of observation which make a child notice things, which, as they say, it ought not to see, and the inquiring turn of mind which makes them say "what's that?" are habits good in themselves, and to be cultivated, but under discipline. In a general way the boy who generally picks up a fossil on the gravel walk is the boy who will detect the queer absolute clause which looks as if it didn't belong to the rest of the sentence, or find out where something had gone wrong in a long calculation. By such considerations I would lead up to the defence of offering to the general public lectures on all sorts of odds and ends of knowledge, simply because they tend to cultivate an enquiring turn of mind, from the gratification of which much innocent pleasure is derived, and there can be no doubt that we may pry into the secrets of the queer old folk who lived in the caves long ages ago, we may open their cupboards and find out all we can about them without offending anybody.

I have selected the subject of caves, as it is one of general interest, and can be easily followed without any extensive technical knowledge, while it involves the consideration of questions of very wide bearing—such as that of the earliest appearance of man in our area, at any rate, if not on the earth. Recent explorations in our district, and the inferences drawn by some of the explorers from the observations made, render this a fitting time to bring the matter before the Society for discussion.

I propose, therefore, to give a sketch of the various kinds of caves and cave deposits, and to discuss their mode of formation and the nature of the evidence upon which theories as to their age have been founded.

To bring the subject clearly before you, I will describe, in detail, one special example where the whole process has been observed by myself, and might again be watched.

There are artificial as well as natural caves, and many natural caves modified by man. In quite recent times, the soft New Red Sandstone has been scooped out into cells and summer-houses. The chalk has been excavated from very early times in the search for flint, and traces of sojourn in such pits are not wanting. We need not stop seriously to discuss the suggestion that Fingal's Cave was excavated by man. The rock-hewn tombs around Jerusalem, the catacombs of Italy and Egypt, are artificial caves.

All along the Vezère and other cliff-margined valleys in the South of France we see the natural caves and rock-shelters, modified sometimes by man, walled up and still occupied as store-houses, or even as dwellings. History tells us that those caves were frequently held by troops during the long occupation of that part of France by the English. The Rock of Tayac, like Gibraltar, "a kind of fortress entirely hollowed out of the rock," is frequently mentioned in the history of the wars of the fourteenth and fifteenth centuries. And the Aquitani, when pressed by Cæsar's troops, retreated to their caves in South-central France. I have heard of a man who lived for some time in a cave in Yorkshire, coming out at night for food; milk from the neighbours' cows, eggs, or whatever else he could lay hands on. I found many odds and ends in that cave which might have been relics of his sojourn, as well as others of more remote antiquity.

There are hardly any records of research in caves which are known to have been occupied in recent or historic times. A systematic examination of all the caves in which history tells us the inhabitants of any district once took refuge, and an exact description of everything observed in them, would be very interesting, and might furnish important evidence bearing upon doubtful questions.

Artificial caves, however, or artificially modified caves, form a very small proportion of those with which we have chiefly to do. The caves in which primæval man lived, and into which in old times hyenas dragged carcasses of the animals they killed or found dead along the river-courses, were all natural caves. So are the celebrated stalactite caves of Germany and America. We must enquire into the mode of formation of natural caves if we would understand the conditions which surrounded primæval man or speculate on his age.

There are sea-caves formed by the waves that lash the cliffs as if sounding them to find their weaker places. The water itself would soon destroy a jointed rock. As each storm-wave rolls in, it deals a tremendous blow on the fissured mass. Every thin packing of clay between contiguous blocks is soon washed out, and the fissures themselves enlarged. Then there comes into play another action. The space behind the block is filled with water; the thumping wave falls on the narrow opening on one side of it; the pressure is communicated to the body of water behind it, and the force being multiplied ten or a hundred times by the hydrostatic paradox, the block is hammered out.

It is clear that such waves and such boulders as we are familiar with on the coast of North Wales would make short work of broken rock or rotten dyke, and any old cave or fissure opened out by the sea would not be likely to have much of the original deposits left in it. The first storm would clear out all earth and bones, and leave in its place only the well-worn pebbles of a rocky shore. By its form and by its contents we could generally make out whether it was a sea-cave or not. We should examine the rock to see whether the parts where the cave expands are those on which the sea would act with greatest force and efficiency, or whether the shape could be better explained by reference to torrents coming in the other way. We should examine the contents to see whether in their character or arrangement they indicated the action of the in-rushing water, or whether they are such as could never have survived the scour of tidal and wind-driven waves. When we have to enquire into the origin of caves in inland cliffs and on mountain-sides, now far above the sea, where many of the traces above-described have been long removed by denudation, there are further tests to be applied. There we should have regard to their manner of occurrence and their place in the physical geography of the neighbourhood. A sea-cave does not necessarily, or even commonly occur in the line of drainage from the uplands, but in the higher cliffs and headlands between the valleys that run down to the sea. Whereas the caves due to subterranean water-courses lie in the lines of drainage; and the caves due to subaërial waste coincide in distribution with the outcrop of the beds that readily lend themselves to that kind of weathering.

Moreover, allowing for the possibility of unequal elevation of different parts of a coast-line, we can still generally find sufficient evidence to show whether the rock in which the cave occurs forms part of an old sea-cliff or of an escarpment.

We must remember also that during the formation of a sea-cave the base of the cliff is being swept by the sea. Sometimes an inland stream washes the base of a rock in which a water-course cave has its outfall, but generally in the case of inland-formed caves a vast mass of talus is being formed along the base of the cliff in which the cave occurs The scour of floods through the cave may keep the mouth open, but as the water is being drained off to other and lower levels, this sweeping of the cave mouth ceases, and the cave deposits show interbedded fallen rock and transported earth and stones, and often the remains of animals.

As a general statement we may say that a typical sea-cave runs into a cliff which rises vertically from the level of the floor of the cave, or is even undercut a little, because the talus has always been removed from the base, so that the fragments break away all over the face of the cliff from top to bottom, and the base sometimes is even undermined by the waves.

In the case of an inland cliff, on the contrary, the fallen rock is not removed, so that only the upper part of the cliff above the sloping mass of talus is exposed to the action of the weather. The exposed part is reduced in height as the talus grows, so that the cliff keeps on receding above only, as the talus keeps covering up more and more of the lower part.

Of course, the sea-cliff, when removed inland by elevation, gets, after a time, eaten back by subaërial weathering, and covered over by talus like any ordinary escarpment.

Gaping fissures of such a character that they could in any case be looked upon as caves are very rare, but the fault-breccia that commonly fills such cracks is easily removed, and the various denuding agencies are apt to follow fissures, and thus caves be formed along them. That is why it so often happens that mines break into caves, or trial holes are made in caves, the fissure vein or lode being seen in the cavernous rock.

The unequal flow of lava curling and coiling over the half-cooled mass of earlier flows sometimes leaves openings like caves; and it is said that some of the caves in volcanic districts are opened out by the various acidic vapours which act on the micaceous and other schistose rocks which have been already fissured by the earthquakes so frequent in those countries—as, for instance, in the case of some of the caves of Corinth and the Cyclades.

These are, however, few and unimportant, seldom occurring where a cave would be much frequented by man or the lower animals.

The commonest caves, and those which generally have proved of greatest interest, are the old subterranean watercourses so frequent in limestone rocks. The way in which these caves are formed is well known, but many of the phenomena connected with them appear to be less clearly understood, and so we hear of various startling theories propounded which, on enquiry, turn out to be based on a wrong interpretation of the mode of formation of the deposits found in such caves. It is to these questions I especially invite attention tonight, and in the selection of examples in illustration I desire to explain the mode of formation of the cave earth and laminated clays, stalagmitic floors, and broken-up travertine breccias, stream-gravel, and angular talus, and to make clear the distinction between the age of the caves and of the cave deposits.

First, I would just remind you that these caves are formed in a rock which can not only be mechanically broken up and carried off, but can also be dissolved in water and carried away in solution wherever water can pass. Even pure water can take up two grains per gallon of carbonate of lime, of which these rocks are largely composed. But pure water is very rarely found in nature. The rain generally takes up some carbonic acid from the air, and when it falls on the ground gets a great deal more from the decomposing vegetation, and water with carbonic acid in it acts rapidly upon the limestone rock, carrying off part of it as a bicarbonate of lime, while the earthy part is washed away in mechanical suspension till it settles down in some pool of still water as mud, often forming a considerable part of the cave-earth which fills all the interstices of the broken rock. As may be seen by the analysis of hard waters, it is not uncommon to get 25 grains per gallon of carbonate of lime in the water of limestone districts, and this implies the never-ceasing operation of the agencies which tend to form caves.

So, of course, the most favourable conditions for the formation of such caves are—First, a limestone into which the water can trickle down along joints and fissures, and find its way out at some lower level. Secondly, an area over which the rain can gather into streamlets and collect from vegetation the acids which will help it to dissolve the rock. The crack into which the water first finds its way may be very small; the water soon opens it out, acting first chemically, then mechanically, on the surrounding rock. When the sand and broken rock get a free passage, mountain torrents, full of débris torn from the hillside or washed out of ancient boulder-clays, are precipitated into the chasms, which take the place of the half-opened joint, and the work goes on apace.

It is quite clear that in such circumstances it must often happen that, as the clay or shale on the hill-side is being denuded away, the water must find its way continually further and further back into the jointed limestone, and, in the deep recesses of the mountain, new channels must often carry off the water that once ran at higher levels. Thus, the original outfalls are left dry, and then they are in a state for man and beast to inhabit. Sometimes, however, when all the hill is full after some great thunderstorm, water spurts out of every joint and spouts in torrents from each cave, and until the cave is quite beyond the chance of such catastrophes, we cannot hope to find a clear continuous record of its old inhabitants.

To give an example of a cave now being formed in one part and periodically modified in another, I will carry you to the flanks of Ingleborough, where the conditions are peculiarly well suited for the formation of caves and for the examination of all the accompanying phenomena. Many of you are familiar with the form of that grand bluff—the most conspicuous feature as you look north from Lancashire towards the borders of Yorkshire and Westmorland. Its flat cap of millstone grit; its steep slopes of rapidly-crumbling Yoredale shale, here and there braced up by *throughs* of sandstone, or grit, or limestone; its great table of Mountain Limestone, on which these all stand; and its base of Cambrian and Silurian, altogether combine to furnish some of the most charming bits of scenery and most interesting bits of geology in the kingdom. On the S.E. slopes of Ingleborough is a great hollow space where the water runs off the impervious Yoredale shale and the patchy drift down to the basement table of Mountain Limestone. The drainage area is about a square mile, and the stream is usually small and generally lost at once in the first open joints of the limestone that it gets to. But a flush of rain-water soon fills these crevices to overflowing, and the surplus water rushes on 100 yards or so to a great chasm, known as Gaping Gill Hole, into which it plunges with a roar. The air dragged down, tangled in the water, ascends in a current, carrying mist and spray far above the chasm's brink. I have watched this wonderful abyss many a day of storm and sunshine. No one has ever been to the bottom of it; but I can tell you something more about it that bears directly on the subject we are considering.

In that country, so favourable for the formation of all the various kinds of swallow-hole, cave, and keld, I once had the good fortune to witness one of those grand storms which in a few minutes change the face of nature, and in a few hours leave a mark that ages may not efface.

I had climbed some way up Ingleborough. It was a glorious July morning. Myriads of insects were busy with their own various pursuits. The haymakers were hard at work; more hurried, perhaps, as the weatherwise saw thickenings towards the south, and felt the sultry heat that warned them there might be a storm. I turned now and then as I got higher, and saw the mist gather on the southern horizon. Soon it took shape and formed in the eddies as the rapidly-rising wind crept on. Two principal masses of cloud came crowding up, converging on Ingleborough, from Lancaster and Clitheroe. I had once before seen that kind of sky in South Wales, and, a few hours after, thirty-eight bridges were carried away in our county. So warned, I hurried homewards, and it was well I did. The clouds appeared to me to be rolling on in vertical planes. I ran, and only just got into my inn before the worst was on us. Drenched haymakers, who had lingered too long in some insufficient temporary shelter, kept coming into the village. The storm burst with all its fury on the south-eastern flank of Ingleborough.

The stream that drains that area runs through the village of Clapham. The valley is dammed close above the village, to form a small tarn. This soon felt the flood, but, of course, the equalising effect of a lake upon the stream below it prevented our realising the tremendous rainfall for a time; because, before the stream could be raised six feet as it flowed out of this lake, the whole area of the lake had to be raised to that extent. But very soon this was done and the arch was filled, and a great spout of turbid water was projected forward on to the rocks at the base of the dam above the church. I went up the valley round the lake towards the celebrated Ingleborough Cave. It was a striking scene. Water spurted out of every crack and joint in the rocks, but the united subterranean water-courses could not carry it all, and the overflow from the drift-covered country above the usual outfalls rushed down the valley, carrying mud and boulders with it in its headlong course. The stream below the cave runs over bare limestone for a considerable distance, and the noise made by the boulders, as they were rolled along the rocky floor, was so great that my companions thought the thunder-storm was beginning again and hurried home. I went on to the great cave. Here I saw a wonderful sight. The lower cave was full, and the water was spouting out of the upper cave, which is usually dry, as you pour water out of the mouth of a kettle; and well it might, for, if the swallow-hole that feeds it was full to overflowing, it had the pressure of more than eleven atmospheres upon it from that alone, to say nothing of some 200 feet fall from the bottom of the swallow-hole to the cave.

This was one of the most instructive geological phenomena it has ever fallen to my lot to witness. Here I saw what was, to all intents and purposes, a local cataclysm. Gentle slopes of pasture, where usually no stream ran, were suddenly gashed by a torrent, and the débris swept far away across the lowlands. Underground passages, high above the present water-channels, were swept clean by the body of water forced through them under enormous pressure. Caves that had been sealed up for years with barriers of stalagmite, which one would have thought might have defied the rush of any flood, were burst open. Most of this débris—all, in fact, that was moved by the first rush of water—was carried down the valley. Some remained around the mouth, and some in embayed corners in the caves. Here we saw fragments of stalagmitic floors, mixed up with débris washed in from the swallow-holes above. Some might have seen here evidence that, after the cave had been formed and occupied and gently filled by earth and coated and partitioned by stalactite and stalagmite, there came an age of flood—perhaps of submergence—when the old deposits were resorted, the old floors broken up, and that the cave then entered upon another phase of its history. How different the facts! I saw this revolution taking place. It was all over in three short hours. It was another illustration of the great law of Uniformitarianism, which I have heard the Duke of Argyll well state thus: *Local catastrophic action is not inconsistent with continuity of causation.*

We must bear these things in mind when we are examining cave-deposits.

The peat torn away from the mountain-side above was so beaten up in this great natural churn that the water of the tarn did not get clear for months. The sediment did not settle for three weeks in a long glass which I filled during the flood. There must have been a layer of fine carbonaceous clay formed over the bottom of the tarn and in many a deep cave-pool after that storm. When the rain ceased, the water soon ran off the mountain-side, and I went up to examine Gaping Gill, the great swallow-hole that feeds the cave. I found a passage opened out among some blocks on one side of the stream a little above the chasm. I thought I might perhaps find a zigzag descent, which would lead me down into Gaping Gill Hole. So I crept in.

I soon got beyond the light, and therefore took the precaution of throwing stones in front of me before I advanced. I found the slope increasing rapidly, and then all of a sudden the stones dropped into a deep hole, down which they whirred, knocking the sides here and there till they dropped, with a booming noise, into deep water below. I wriggled out, and returned another day, with friends and candles and string, for I could not drop the stones straight so as to clear the sides, and so estimate the depth by the time they took in falling. Sometimes the weight I attached to the string was too small, so that the increased weight of the string itself, when wetted by the splash of underground waters, prevented my being able io judge whether my plummet had touched the surface of the water below or not. Sometimes the jagged rocks cut my string, and I lost hundreds of feet in this way. At last, however, I got the right sort of string and a convenient weight, and I found that the water here plunged into a vertical hole 360 feet from the grass-covered turf above.

This was not, however, the principal chasm, and I saw a curious sight on the southern, or lowest, face of the great chasm beyond: it was battered and bruised as if it had been bombarded for hours, and so it had. In that flood hundreds of boulders, carried forward by the rush of water, were hurled against the opposite face of rock, and then, dropping into the great chasm, were hurried away through the subterranean water-courses and caves down to the valley far below, where they still rolled on with a noise like thunder over the smooth rocky bed of the stream, till arrested when the velocity of the water was checked in the wider spaces, or finally stopped in the little tarn below.

Here was the whole story of the formation and infilling of limestone caves, and the sudden breaking up of all the older deposits; and the return of tranquil deposition to be read in Nature's clearest writing.

First, we saw the results of the chemical action of the acidulated water running off the peaty moor, and opening out the crevices in the jointed limestone.

Then, there was the mechanical action observed on a grand scale in storm—the boulders and pebbles pounding away the solid rock. And next, there was the sand and mud left as the water subsided, and the old state of things returned.

Another curious fact I noticed, which shows how the fragmentary rock is rubbed down into mud by the action of running water. There was a fetid smell arising from this flood water, such as the people about there said they had not perceived before. I followed up the stream, and noticed a great quantity of black sand thrown down here and there along its course. This was derived from the bituminous limestones of the lower part of the Yoredale rocks and the upper part of the mountain limestone, and I at once suspected the cause of the smell When I rubbed a handful of this sand together there was the same fetid smell at once produced. The air, tangled in the seething flood, was carried down the valley, and, when released, gave off the gases caught up from the pounded rock.

As we cannot follow these watercourses down from above through all their subterranean wanderings, let us go down into the valley below where the water comes down, and see if we can work our way back into the hill towards the foot of the great chasm, and see what is going on there. It is here we find what is more properly a cave being formed. The water drops from one level to another, then runs along between the beds, and drops again. By putting your ear to the fissured rock in one place, you can hear, from the deep recesses of the earth, the sound of a waterfall that man has never seen. Not far off, a beautiful clear river flows out of the lower cave. This is 600 feet below the swallow-hole, where the water enters on the hill above. When the rain floods the stream above, this, too, runs turbid. Some 20 feet above it is the entrance to the other cave, the celebrated Ingleborough Cave, a more ancient outfall for the water, which now runs at the lower level.

This cave was explored many years ago by Mr. James Farrer. I have followed it for about a quarter of a mile, and, with some others, been let down to a lower level at the end. We squeezed our way along till we came to a long, deep cave, full of water, which seemed to flow gently towards the mouth of the lower cave In the great flood of 1872, all the subterranean caves and fissures were filled, and the water spouted out of the upper cave, carrying along with it great masses of rock, which helped to break up the stalagmitic floors and barriers. This flood was so exceptional that most of the débris was carried clean away; but we saw, when we examined the ground round the mouth of the cave, and the well-known passages inside, what had been going on; how stalagmitic floors had been undermined, broken up, and redeposited, and how the torrent débris was sometimes left in the embayed corners of a limestone cave. But this was a cave not far above the existing watercourse. When a cave has been formed in the side of a rapidly-deepened gorge, where, however high the flood may rise, the water can never sweep it out with a rush, gentler processes of denudation and deposition still go on. The débris that falls about the mouth poonds back the rain, and gathers in the fissured rock, and turns in the rivulet that would have trickled down the hill. The damp clay clings to the rock and frets away its surface, and things washed in work their way down along the face of the opening, gradually-weathered limestone, and lie in clay washed down with them.

It is easy to distinguish the chemically-fretted rock from that which has been worn, smoothed, and rounded by the mechanical action of the sand and pebble-laden water, as you can distinguish the pholas-bored rock from that in which the holes are due to weathering. On the chemically-weathered surface the less soluble grains and bands stand out. This is a useful test.

When any partly-closed cave is invaded by periodic rushes of rain-water, the débris is carried down from above through fissures, or washed in from the mouth, and so we find resorted drift and the material of the rainwash from the surface-soil above the cave occurring also in layers in the cave; and if the cave happens to be occupied by wild animals when not flooded, we find their bones and the remains of their food scattered over the floor or buried in the rainwash.

But when the turbid water fills a pool in the cave or a pond outside it, and the mud is allowed to settle down quietly, the coarser falls first and the finest last. Then the water evaporates or soaks through the sides, or remains clear and tranquil till the next rain carries in a flood of muddy water. The deposit so formed will have a tendency to split along the layers of coarser sand or loam which first settled down after flood—that is, it would be a laminated clay. As long as the pool was about the same depth, and the amount of mud carried in suspension in the water was the same, the thickness of the laminæ would be practically the same, representing just the mud in one pondful of turbid water, whatever the interval between the refilling of the pond might be. The turbid water may come from the bottom of a glacier, or from melting snow, or from a heavy rainfall; but it certainly has no necessary connection with glacial action. We see laminated clay so formed commonly in the corner of any old quarry, in ditches, or in caves.

In Chapel le Dale, a valley on the west side of Ingleborough, there is a beautiful chasm which has been so opened out by the action of the torrent, that you can get down to the bottom, where the water plunges on to a bed of broken rock and pebbles, through which it passes, as through a sieve or very coarse filter, into the water-courses that carry it off down Chapel le Dale. This great chasm is probably a fair representative of all the large swallow-holes. Hull Pot and Hunt Pot, on the flanks of Whernside, are of the same kind. Probably, there is in Gaping Gill, somewhere, a place where the water in ordinary weather filters through coarse gravel, for I have sent down many boards with a notice on each that I would reward any person who brought it back to me, but I have never heard of one of my notices being found. Yet, at times great boulders do get through, so it may be that the paint of my notices was destroyed in the subterranean waterfalls and rapids.

These chasms or funnel-shaped holes are the feeders of the caves. They are only vertical caves formed in the horizontal surface of the rock. They are known as swallow-holes, Pot-holes, Sink-holes, and in Italy as Dolinas. They have various local names, expressing the idea that they are not part of the more regular and common operations of nature: the Devil's Chaldron, as in French, Chaldrons du Diable, Marmites des Géants, Bêtoires, or, more simply named, they are the Katabothra of the Greeks.

They begin sometimes under the covering of drift, and, when the opening grows too large, or the covering soil is sodden and will not hold its own weight together, the surface breaks in. Mr. Haythornthwaite, of Kirby Lonsdale, told me that on a farm of his above Wethercote Cave, after wet weather, he once saw one fall in.

The age of the cave-deposits is quite a separate question from that of the caves themselves. The formation of the caves was a time of destruction; but the infilling of the caves belonged to a time of accumulation—when there was no great scour through the caves, but the rain carried in earth and stones, if there was loose drift above, or only muddy water if the cave was nearly closed, or perhaps nothing was deposited but the fine unctuous clayey residuum of the chemically-decomposed limestone itself. Angular fragments disengaged by frost or heat formed a barricade about the mouth. Bones were washed in or carried there by beasts of prey—and by man. Buckland referred most of the caves that he explored to hyena-dens. Constant Prevost thought the bones that occurred so thickly in the cave-earth in Franconia were all washed in by torrents. This explanation will hold only in exceptional cases. The bones may have been washed from one part to the other of a cave, and a few do get washed in from above. I have seen three sheep being carried down towards a swallow-hole, and have found two drowned rabbits and some dead trout on the gravel at the bottom of Hunt Pot, on the flanks of Whernside. But we never see the ground so covered with bones of various animals that a flood would wash them into caves and form an ossiferous deposit like that in the caves of Franconia.

There can be, however, no general explanation for all bone-bearing caves. We must examine all the evidence in each case, and then form our opinion as to how a particular bone-bed was formed. Buckland's views seems to me to be in most cases the correct one.

So are caves formed and modified and filled and swept clean and filled again, and we must bear all these facts in mind when we attempt to read the story of a cave from the deposits which we find in it.

Broken-up stalagmitic floors are not evidence of the action of the sea, but, on the contrary, must generally be referred to land floods.

Laminated clays are not evidence of glacial action, but only of alternations of muddy and clear water, such as follow rainy and fair weather.

Some of the most interesting caves, in respect of their contents and the light they throw on the history of primæval man, are only rock-shelters—abris—such as are seen in the Dordogne district, and are common in our district along the valley of the Elwy. They are sometimes longitudinal sections of parts of subterranean watercourses, but are more commonly due to the weathering away of soft rock between two harder beds. It does not always require a stream or direct rainfall to wet the surface of a rock. The travelling moisture of the air, condensed in and on the cold rock, is enough, and is probably the chief agent in case of a rock undercut so far that the rain cannot touch it, just as Rendu explains the film of ice upon the snow at high elevations, not by the melting and refreezing of the snow, but by the condensation of the little moisture left in the air which comes in contact with the snow in those high regions.

Turning now to the Vale of Clwyd, we find there many caves representing subterranean channels, through which the water running off the Silurian hills around dropped into fissures on reaching the mountain limestone, and following now the faults, now the joints, and now the bedding, found its way down to the lower ground. This was, of course, a process which extended over a long time. While the main valley was being scooped out the tributary gorges were being cut back, and so the underground watercourses kept finding lower outfalls, leaving their old channels as dry caves. It is clear, therefore, that the caves are of different ages, and the evidence of their antiquity must be sought in the physical geography of the district. The age of their contents is a separate question. The Plas Heaton *cave* seems to belong to a very remote period, and the stream that ran through it had been cut off by later denudation either in the gorge of the Elwy, or in the valley that runs into the Elwy below Llysmeirchion. Yet the *deposits* of Plas Heaton cave have not yielded evidence of very great antiquity. Some of them indeed must have been washed in in quite recent times, for I found pieces of old magnums in the cave earth beyond where man could creep when first I knew the cave. The other end of this cave was blocked with clay full of boulders—a mass indistinguishable from the clayey Clwydian drift. The Pontnewydd Cave is one of the numerous old watercourses which represent the ancient subterraneous drainage of the Elwy valley. It occurs some way down the precipitous slopes of the Elwy behind Cefn. The other end of that cave has not yet been found. In it were felstone implements and flint flakes, and a mass of stuff washed in from either entrance, and along all fissures which communicated with the once drift-covered surface above.

The limestone on both sides of the little ravine which runs down into the Vale of Clwyd at Ffynon Beuno, near the village of Tremeirchion, is perforated with numerous caves and cavernous places. One face of rock in particular has much interest attached to it, owing to the excavations which have been recently carried on in it by Dr. Hicks and Mr. Bouverie Luxmoore, whose interpretation of the observations made involves various questions still under discussion. The first notice of these caves that I know of is in the report of an excursion of the Chester Natural Science Society (see *Chester Courant*, July 26, 1883.) The caves coincide more or less with lines of joint and faults along which calc spar and various minerals suggested the possibility of lead ore. Trials had therefore been made in the cave, and the cave earth had been turned over in places. The fragments of bone lying about were sufficient to suggest that the sheep and fox of to-day must have been once represented by the stag and hyæna. I proposed to the Society to open the caves if permission could be obtained, and foretold the probability of our obtaining in them the remains of primæval man. The following year a member of the Chester Society, Dr. Hicks, excavated near the mouth of the lower cave and obtained such interesting results that he applied for a grant first from the Royal Society and afterwards from the British Association to enable him to carry on the explorations, the results of which he has laid before the Association, and other scientific societies. As I have explained above, there is inside of, and more especially at the mouth of most caves, a breccia consisting of angular fragments which have fallen from the rock, while the cave was exposed to changes in the amount of moisture and in the temperature. Sometimes the mouth is blocked by a perfect barricade of large blocks which have fallen from the face of the rock where most exposed. This was very conspicuous at Plas Heaton. At Ffynon Beuno, however, the fragments were small. This depends much upon the extent to which the rock is traversed by joints. The fragments are generally embedded in cave earth, some of which is the red earthy residuum of the decomposed limestone. In the Cae Gwyn cave, that is the upper cave at Ffynon Beuno, this limestone breccia consisted of large masses of rock which had broken down and lay on the cave deposits containing bones. Just within this newly-exposed opening into the cave under a projecting mass of rock, which was removed with a view to making steps up to the surface of the ground outside, Dr. Hicks, Mr. Morton, and the workman saw a flint flake taken out from the bed of limestone breccia in which bones occurred. A similar deposit extended under the sandy drift with boulders as far out as the excavation was then carried. This is conclusive against the drift which rested on it being shore deposits of the undisturbed marine Clwydian drift, as it is quite impossible that the lashing waves on a rock-bound shore, exposed to the North-west winds, should not have swept such loose debris into the deep fiord below. That is probably why we have not yet and possibly may not in any such situation find the cave deposits of the age just before the submergence—such a cave as that of Cae Gwyn would have been swilled out quite clean by every tide. The drift settled down in the depths below, beyond the reach of wind and waves, where none but mermaids can have carried flint flakes into the caves. [But on re-elevation, behind this deposit and behind the limestone, there was a cave inhabited by the hyæna, and perhaps man, the wall of which subsequently broke in and formed a new opening.] That limestone talus should contain the remains of palæolithic man and other animals is not new. On the slopes of Mount Salève, south of Geneva, flint flakes were found in abundance in such talus associated with bones of reindeer. That the infilling of these caves was not due to the waves is clear from the character and disposition of the deposits in Plas Heaton and Cae Gwyn. The shingle is not driven in to form a great upsloping bank, such as may be seen in any cave reached by the tide, as for instance round our own coasts in Devonshire, at St. David's, or further off on the shore below Biarritz—or even as seen in the caves along the shore of "the tideless dolorous midland sea," where the wind-waves sort and carry the material in the same way, though on a smaller scale, into the caves along the Riviera. Next we may enquire whether it was possible that these caves of Plas Heaton and Cae Gwyn were formed and inhabited by man and the hyæna before the submergence, and that the mouths of each of these caves was sealed up by the Clwydian drift during the submergence. The reply to this is conclusive. In and around the mouth of the cave pieces of north country rocks, granite, etc., were found. These came into the district first with the Clwydian drift. So no deposit containing north country granite can be earlier than the submergence, and the argument brought forward above against the caves having been occupied just as the sea was at their level applies to this other view also. The sea that could bring the drift and lay it on the bone breccia outside the mouth of the cave would have swept the breccia away or sorted it differently. If then the cave deposits cannot have been formed *before the submergence*, because rocks first brought into the district *during the submergence* are found in and at the mouth of the cave, and debris derived from this drift is found in the cave; and if further from the character and distribution of the cave deposits they cannot be due to marine action *during the submergence*, it follows that they must be referred to an age *subsequent to the submergence*; and we must now consider the associated drifts in view of this fact. First, then, I would point out that if the material which blocked the N.W. end of the cave were Clwydian drift it does not make the cave deposits pre-glacial, for as I have already shown in a paper read before the Chester Natural Science Society, November, 1880, the last glacial deposit was the boulder clay with blocks from Snowdon or Arenig, and the Clwydian drift is that older drift resorted during the submergence, which is shown by its fauna to be post-glacial. But this is not the only point. The drift blocked up only one end of the caves. In the case of the Plas Heaton cave, as in that of Cae Gwyn, one end of the cave was open; so that there is no difficulty about the manner of occurrence of any of the objects except those in and under the drift at the upper entrance. In some of the caves in the Valley of the Elwy, the direction in which the principal part of the coarser material of which these cave deposits were made up had been carried was pretty clear, namely, from the drift covered end, by water getting in along porous beds and fissures. In later times the caves got nearly filled by ordinary cave deposits, the result of the decomposition of the limestone, and the clay and sand washed in through fissures In the Plas Heaton cave, the mass of drift overlying the north end of the cave does seem to be the Clwydian drift, or derived directly from it. But in the case of the Cae Gwyn cave I do not feel at all sure of this. The material that I saw in the section when we first broke out to-day from the inside of the cave, namely, that which had fallen into the cave through the swallow hole, did not appear to me to resemble any known section in the undisturbed Clwydian drift. It is quite unlike the great masses of red sand exposed here and there in the Wheeler valley. There is nothing in the section below the Mount, or at Bryn Elwy, at all resembling it. It is not like the drift of Wigfair-isaf, or the variable deposits of Wigfair-uchaf—except in each case the obvious top few feet of rainwash It is like the mixed mud and sand and gravel which we find everywhere overlying the Clwydian drift, crumbling down the hill side, and conforming to the slope of the ground. There is no sorting of the material as we should expect if currents ran along the rock face or waves dashed against it, but there is here and there an obscure and gentle falsebidding from the cliff as of rainwash creeping down the slope. To show the scratched stones from Arenig is to prove too much or too little. There can have been no man or hyænas there when the ice sheet from the Snowdonian and Arenig mountains carried moraine matter across the Vale of Clwyd. There are no scratched stones among the included rocks which are peculiar to the Clwydian drift, and if all the scratched stones are derivative, they must have been washed from the old Snowdonian drift into the Clwydian drift, or from that into the rainwash, and may be handed on still. Again, at Plas Heaton the northern end of the cave is buried in a mass of clay, which if it does not belong to the Clwydian drift must have slipped down bodily. There is no long slope of ground above it to cause any crumbling down of all the superficial deposits from above. At Ffynon Beuno, on the other hand, the superficial deposits are creeping down the hill sides, hanging on every ledge, and catching on every obstacle. Any old hedge proves how rapidly this process is going on. One such hedge ran across the bottom of the field in which the northern end of the cave comes out, passing up to the edge of the precipice about 20 feet below where the higher end of the cave comes out. There we see that the "head" or travelling talus has been banked up on the upper side of the hedge, so that there is a fall of some eight feet from the field on the upper side of the hedge to the natural level below it, which also has been somewhat lowered by the general working of the soil down the slope. This superficial talus is the upper part of what has been dug through at the upper or swallow-hole entrance of the cave, yet it has not been distinguished as different from that which has by some been taken as part of the main mass of the drift. If, after an inspection of the ground, any doubt remained as to the recent date of some, at any rate, of the material which covered the northern mouth of the cave, and which was all equally referred to the age of the Clwydian drift, a more careful inspection of the glaciated stones out of the mass should dispel it. There were plenty of glaciated stones, as may be found everywhere along the flank of the hill; but some of these, in addition to the more or less well-preserved glacial striæ, carried the rough irregular grooves of agricultural implements. The tilled soil and the rainwash rapidly accumulates on ledges and against fences on the slopes of the Clwydian range.

I do not for a moment deny the possibility, or even probability, of our some day finding a cave which was formed before the great Clwydian-drift submergence, or even before the great Snowdonian ice rode over the Vale of Clwyd on to the Cheshire plains; but such caves will be few, and their age hard to prove, for many will have been altogether destroyed by denudation, and most will have got swilled out by marine and subaërial currents, and no trace of their first inhabitants will have been left. The question is one of so great interest that we are justified in asking for very clear evidence in each case in which it is stated that remains of such antiquity have been found in caves before we admit the proof. Turning now from the stratigraphical to the palæontological evidence, we get the same result. If ever we come upon pre-glacial caves we may expect Pliocene animals, and if we find caves belonging to an age anterior to the great submergence, it is probable that the animals whose remains are found in them will belong to an older group than those found in deposits later than the submergence. But we have not an older group in the Ffynon Beuno cave. We find there the animals of the newer post-glacial gravels of the South and East of England. The absence of shells in any of these deposits, as far as such negative evidence is of any value, certainly goes to confirm the idea that they have been much modified, if not transported down-hill by subaërial action. Fragments of shells are found not uncommonly in the Clwydian drift, along the River Elwy, but not in the deposits which most resemble it about Ffynon Beuno. [They have since been found, see below.] Moreover, the surface of the limestone fragments was decomposed in the drift outside the cave, leaving the less soluble bands sticking out in sharp relief, and showing a chemically-fretted surface, and not such as is seen on stones rolled in a current, though common on those found travelling in rainwash. So we may suppose that if there had been shells in that part of the drift, they must have perished altogether, leaving no trace. The surface of the solid rock over and round the mouth of the cave was similarly weathered, and the deep undercut ledges are such as are commonly found along all cliffs of the mountain-limestone where exposed to chemical and ordinary subaërial weathering, and not rounded off by the breakers or by ice action. There was no trace of smoothing by ice from the north, or from any other quarter. On the whole, the conclusion seems to be that there were no cave deposits of pre-glacial age yet found in the Vale of Clwyd ; that there were none earlier than the great post-glacial submergence ; that the group of animals found in the Ffynon Beuno caves were, so far, found only in deposits laid down after the land had begun to rise again, but at what stage of the emergence there was not as yet sufficient evidence to show ; that the points upon which evidence was most required were the age and fossil contents of the Talargoch gravels, which there are reasons for suspecting were much later than the main mass of the Clwydian drift.

SUPPLEMENT.

Since this paper was read further excavations have been made and more evidence has been obtained, all of which fully confirms the views above stated, viz., that the deposits in the cave are post-glacial—that the deposit which was looped down over the most northern explored part of the cave, and filled the only opening through which a man or hyæna could have crept in at this end, was rainwash, or resorted from the Clwydian drift ; that the appearance of the true Clwydian drift resting on cave deposits was deceptive, being due to the breaking down of a portion of the side of the cave and the sinking in of the limestone and of the Clwydian drift on to the cave deposits—so that they might as well be called pre-Carboniferous as pre-Clwydian on such evidence.

I append the list of shells found in the genuine Clwydian Drift outside the cave, as determined by Mrs. McKenny Hughes, from which it will be seen that even had the cave been blocked by this drift, its contents could not, on the evidence of the shells, be claimed as pre-glacial. I give also a list of the mammalia found in the cave, determined by Mr Davies, of the British Museum, from which it will be obvious that there is nothing in the fauna to favour the idea of the cave deposits being of pre-glacial age.

By permission of the Council of the Geological Society, I give a plan of the cave and two sections, in which the position and character of the break-down of the side of the cave, and the manner of settling down of the post-Clwydian rainwash, &c., may be seen. These, with a full exposition of the newer evidence, were published in the Quarterly Journal of the Geological Society for February, 1888.

The old excavation at the upper mouth of the Cae Gwyn Cave was reopened, and a clear section cut through the "Head" into the undisturbed drift, in which last, at a distance of some 8 feet from the rock above the cave and about 7 feet below the surface of the ground, in a bed of sandy clay (see fig. 1.), 17 species of shells were found, of which the list is recorded in column I. of the following Table. A full list of the shells found in the drift of St. Asaph and Colwyn is given in column II., and in columns III., IV., and V. I have shown which of these occur at Rhyl, or on any part of the British coast, or in the Bridlington Drift.

	Cae Gwyn. I.	St. Asaph and Colwyn. II.	Rhyl. III.	British Coast. IV.	Bridlington. V.
Ostrea edulis, *Linn.*	*	*	*	*	
Mytilus edulis, *Linn.*	*	*	*	*	*
——(Modiola) modiolus, *Linn.*	..	*	*	*	*
Nucula nucleus, *Linn.*	..	*	*	*	*
Pectunculus glycymeris, *Linn*	*	*	..	*	*
Cardium echinatum, *Linn.*	*	*	*	*	
—— edule, *Linn.*	*	*	*	*	*
Cyprina islandica, *Linn*	*	*	*	*	*
Astarte borealis, *Chemn.*	*	*	..	..	*
—— sulcata, *Da Costa*	*	*	..	*	*
—— sulcata, var. elliptica	..	*	..	*	*
Artemis exoleta, *Linn.*	..	*	*	*	
—— lincta, *Pult.*	*	..	*	*	
Venus gallina, *Linn.*	?	?	*	*	
Tapes, sp.	?	?	*	*	
Tellina balthica = solidula	*	*	*	*	*
Psammobia ferroënsis, *Chemn.*	*	*	*	*	
Donax anatinus, *Lamk.*	*	?	*	*	*
Mactra solida, *Linn.*	..	*	*	*	
—— solida, var. elliptica = ovalis	..	*	*	*	*
Corbula gibba, *Olivi*	..	*	*	*	*
Mya truncata, *Linn*	*	*	*	*	*
Dentalium, sp.	..	*	..	*	*
Fissurella græca, *Linn*	*	..	..	*	
Littorina littorea, *Linn.*	..	*	*	*	*
—— obtusata, *Linn.*	*	..	*	*	
Turritella terebra, *Linn.*	*	*	*	*	*
Purpura lapillus, *Linn.*	..	*	*	*	*
Buccinum undatum, *Linn.*	*	*	*	*	*
Murex erinaceus, *Linn.*	..	*	*	*	
Trophon clathratus, *Linn.*	..	*	..	..	*
—— truncatus, *Ström.*	..	*	..	*	*
Fusus antiquus, *Linn.*	..	*	*	*	
Nassa reticulata, *Linn.*	..	*	*	*	
Pleurotoma rufa, *Mont.*	..	*	..	*	
—— turricula, *Mont.*	..	*	*	*	*
Balanus, sp.	..	*	*	*	*
Cliona	..	*	*	*	*

All these are recorded by Gwyn Jeffreys as now occurring on the coast of the British Isles, except *Astarte borealis*, of which only dead and, possibly, derived shells have been found. All except *Pecten varius* and *Fissurella græca* have been found in the marine drift of St. Asaph and Colwyn ; and the two exceptions go for nothing, as these shells are common on our coast at the present day.

There is only the *Astarte borealis* which is locally extinct, and it occurs in the high and low marine terraces, from Moel Tryfan to Macclesfield. It has gone north, while all the other shells still live on our coast.

In deposits of such antiquity we might expect to find some locally extinct forms; but no one who compares the shells found in the drift outside Cae Gwyn Cave with those of any of the undoubted glacial deposits, such as that at Bridlington, could allow that the Cae Gwyn shells indicate glacial conditions.

Some have seen on the shells in the St. Asaph Drift, outside the Cae Gwyn Cave, and elsewhere, small striæ, which they refer to glacial action. I have, however, picked up on the coast of North Wales this year fragments of shell which are similarly scored by the accidents of a gravel beach. Some are from Deganwy, some from the Menai Straits, all too far from any shell-bearing drift to have been derived from it.

It has been remarked that the shells in these marine drifts, though nearly all of existing species, are thicker than those now living on our coasts. It is natural that the thicker shells and the thicker parts of shells should have the best chance of being preserved among the stones and sand of a sea-beach ; but I have failed to see any difference in this respect between the shells in the marine drift of the Vale of Clwyd, or the equivalent beds elsewhere, and those found in modern deposits of the same character on our coast at the present day. I have found recent specimens on the coast of North Wales or further south, quite as thick as, or rather, I should say, much thicker than any of those in the marine drift.

In many cases the southern varieties are characterized by their thickness and the northern by their thinness, as, for example, in the case of *Tellina Balthica*, of which Gwyn Jeffreys says: "Our usual form (which may be termed *solidula*) abounds in all the Tertiary deposits, including the boulder-clay or 'till' and the Mammalian Crag. It may, therefore, be regarded in the main as a northern species ; but it is likewise common in many parts of the south of Europe." The variety *attenuata*, in which the shell is smaller, more compressed, and of a *thinner* consistency, is the *Baltic* form.

In the var. *truncata* of *Mactra solida* the shell is *thicker* and the teeth *stronger*. This form occurs "South of Devon and Cornwall, Tenby, Irish Coasts, Firth of Forth, Clyde district, Orkneys, and Lerwick." *Mactra solida* and the variety *truncata* have been chiefly noticed as littoral and in *southern* latitudes, their furthest limit being Sicily, where the former is also fossil; the only northern locality that appears to be recorded is the Scandinavian coast, on the authority of O. F. Müller. The variety *elliptica* ("shell invariably smaller than the typical form, broader in proportion to its length, in consequence of the sides being more produced, and of a *thinner* texture") has essentially a northern range, from Iceland to Kulla in the south of Sweden.

These shells prove conclusively that the high-level drift at Cae Gwyn is not "a true undisturbed glacial deposit," but that it belongs to the St. Asaph division of the Clwydian Drift, which "is mainly remanié."

The list of mammals found in the cave is, according to MR. DAVIES:—

Felis leo var. spelæa	*Bos or Bison*
F. catus ferus	*Cervus giganteus*
Hyæna crocuta var. spelæa	*C. elaphus*
Canis lupus	*C. capreolus*
C. vulpus	*C. tarandus*
Ursus sp.	*Equus caballus*
Meles taxus	*Rhinoceros tichorhinus*
Sus scrofa	*Elephas primigenius*

These are clearly the animals of the newer post-glacial gravels of the South and East of England. We have *E. primigenius*, not *E. antiquus*, or *E. meridionalis*; *R. tichorhinus*, not *R. megarhinus*; *C. tarandus* and *C. megaceros*, not *C. verticornis* or *C. Sedgwickii*.

Recent excavations have conclusively proved that the upper opening now seen did not exist as an entrance to the cave during the period of its occupation, although many fissures and cylindrical holes, sometimes open sometimes choked, lead from the surface of the rock and the water-carrying strata of the overlying drift into this part of the cave.

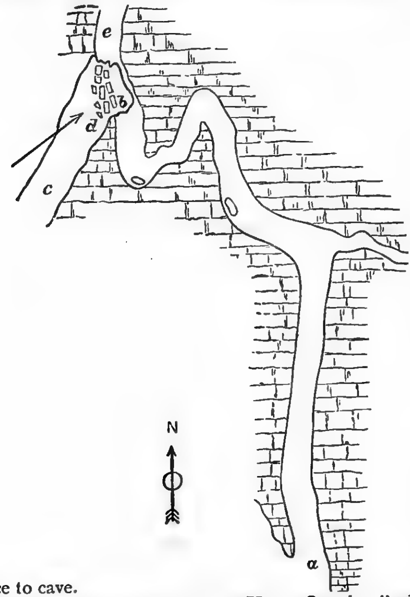
When the bone-earth was followed out from the upper opening it was found to be overlain by a mass of broken limestone, which the floor of solid rock rose to meet, at a distance of some 6 feet more or less from the inner wall of the cave (see fig 3.) This mass of angular rock sloped in over the cave-deposits, and, when followed to the north end of the excavation in front of the opening, it was seen to extend from the floor of the cave to meet the rock above, which again projected forward to form a roof to the cave. Broken rock extended in a similar manner in front of the opening up to the exterior wall of the cave at the south end of the excavation, and, immediately in front of the cave, great masses of rock were found in the soil and drift that blocks the opening (as seen in figs. 2 and 3.) It was perfectly clear that these masses of rock represented the roof and walls of a portion of the cave which had yielded to subterranean denudation and gradually crumbled down or collapsed more rapidly. SIR ARCHIBALD GEIKIE, who visited the cave in October, quite concurred in this view.

So the bone-earth which was said to occur 4 feet beyond the entrance to the cave was really all within the original cave before this portion of the wall had fallen in.

It was impossible that this could be an ancient mouth of a cave round which talus from the rock above had accumulated, and that the sea had afterwards crept over it and deposited the marine drift upon it, because the great angular blocks occurred at various levels in the clayey and sandy débris, and the drift was crushed in upon some of the fallen masses so as to stand vertically, with the included fragments arranged as in the case of the drift in the quarry on the other side of the valley, where also it has sunk into fissures and caves of the limestone.

The pebbles stood with their longer axes vertical, and the bed of grey clay was even a little reversed in places. The inclination of the beds decreased through about 4 feet of angular limestone and overlying sand and loam till the drift by degrees resumed its almost horizontal position.

Fig. 1.—*Plan of Cae Gwyn Cave.* (Scale 34 feet to 1 inch.)



a. Entrance to cave.
b. Break in the side of cave known as "Upper Opening," where the bones, &c., were found outside the then existing cave.
c. Cutting made after discovery of the upper opening *b*.
d. Débris of roof and wall of cave overlying bone-earth.
e. Extension of cave to the north along which water now drains away under the drift

The arrow indicates the point of view in fig. 2.

We have now the clearest evidence as to the exact manner in which it has all been brought about.

The marine drift was deposited before the occupation of the cave by the animals whose remains have been found in it.

At the time of the occupation of the cave the upper opening (*b*, fig. 1) did not exist, but the animals got in by the other entrance (*a*, fig. 1.)

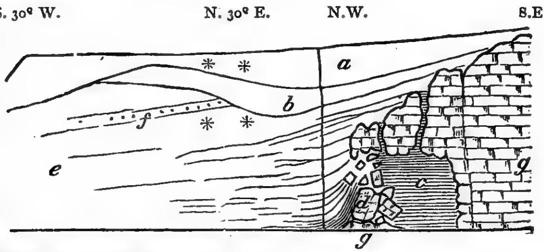
Against the wall of the cave, where it approached nearest to the face of the cliff, the drift lay thick, as we now see it close by (fig. 2.)

By swallow-hole action the cave was first partially filled, and then the thinnest portion of its wall gave way, burying the bone-earth below it, and letting down some of the drift and newer superficial deposits above it.

FIG. 2.

The left-hand portion represents the section seen along the north-west face of the cutting in September, 1887, and shows the festooning of the upper part of the superficial deposits at the margin of the swallow-hole. The right-hand portion is the section along the north-east face as exposed by the excavations carried on in October following.

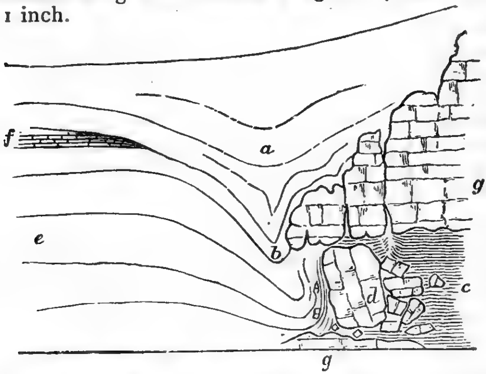
(Scale 20 feet to 1 inch.)



a. Head, Rainwash, Run-of-the-Hill.
b. Moved drift; marginal portion of that which slipped into swallow-hole, and finally closed the upper opening.
c. Cave-deposits.
d. Angular limestone; broken-down wall and roof of cave.
e. Marine Drift.
f. Shell-bed in drift.
g. Limestone.

This is the section as seen by GENERAL PITT-RIVERS and DR. JOHN EVANS in September. This face was afterwards cut back a little, but still, in October, the section showed the margin of the looped drift cutting off the shell-bed and the surface-soil falling with it in towards the swallow-hole The section facing the observer, looking a little east of north along the length of the pit, showed this surface-soil about 4 feet deep, moved drift 4 feet deep, red clay a few inches; this red clay was very irregular and consisted chiefly of the earthy residuum of the decomposed limestone, corresponding to some of the clay with flints of the Chalk districts. The surface-soil and moved drift thinned off against the rock a little further east, as shown in the diagram, fig. 3. The core of the principal swallow-hole has, of

Fig. 3.—*Diagram-section, showing the looping-down of the deposits into the swallow-hole before the Section was cut back as far as represented in* fig. 2. Index as in fig. 2. (Scale about 11 ft. to 1 inch.



course long gone; it was where the earth fell in in the winter of 1886 (see fig. 3), just over where, according to my view, the water soaked first through the jointed, fissured, and funnelled rock into the cave, as it did afterwards through the great angular masses of limestone derived from the breaking down of the wall and roof of the cave. Some of the superficial deposit was of so late a date that the marks of plough and harrow were found on the included stones.

The cave had been filled in the usual way with material from superficial deposits washed in through openings, or from the decay of the rock, or carried in by beasts. The sand that occurred all along it was such as would be derived from the running sand of the drift outside, which is still being carried in in wet weather.

The estuary of the Conway offers the most nearly similar conditions to those which must have prevailed in the estuary of the Clwyd during the submergence: if we could imagine the whole of the Vale of Clwyd submerged to a depth of some 400 feet; cliffs of ancient drift being wasted in one place, and the solid rock touched in another; here banks thrown up which divert the currents, and clay and sand and gravel alternating. Fragmentary shells in exactly the same condition, the same part preserved, and most of them of the very same species as those in the Vale of Clwyd, occur in the shore-deposits of Deganwy. But wander on to where the sea rises and falls across the terraced rock, and stand there while the waves are moved by even such a breeze as would just let you sail a boat, and judge whether any loose subaërial deposit could remain

The Chester Mysteries, and their connection with English Literature and the English Drama.

BY MRS. HENRY SANDFORD.

Read March 10th, 1890.

IT was simply as a student of English literature, and long before I had any idea of ever coming to live in Chester, that I first became acquainted with that

. . . "celebrated collection of mysteries, founded upon Scriptural subjects, and formerly represented by the trades of Chester at Whitsuntide," . . .

which is to be the subject of the present paper. I will, therefore, ask leave to begin where I began myself, namely, with the connection of the Chester Mysteries, and, of course, also and equally, of all the other collections of mysteries and miracle plays, that have come down to us from the Middle Ages, with English literature and with the English drama.

No country can ever boast of more than a very few names (many countries have not even one), either in art or in literature, that so transcend the limitations of time and place, as to stand forth pre-eminent in universal recognition, and for uncounted generations. There was but *one* of his contemporaries of whom Ben Jonson *could* write that "he was not for an age, but for all time;" and it was in Shakespeare that—after centuries of growth and effort—the English nation *first* proved the maturity of its powers, by bringing forth a mind of this rare degree of excellence. What must ever be an interesting question is to consider how it came to pass that the genius of Shakespeare—that is to say, the genius of the English nation, touching for the first time the highest point of literary attainment—manifested itself in the particular shape that it actually did assume, namely, in those dramatic masterpieces which form so precious a part of our national inheritance.

The simplest answer is, that the English nation, before the final triumph of the Puritan movement in the field of social life, was, and had been for generations, one of the most dramatic nations in Europe. Acting was the common delight of all classes, the amusement that naturally suggested itself at any festive season, so that Prospero arranging a masque to celebrate his daughter's betrothal,—Bottom and his companions getting up their rustic play to please Duke Theseus,—Julia, in the "Two Gentlemen of Verona," telling about the dressing up that went on at Pentecost, "when all their pageants of delight were played," are nothing else but pictures drawn from life,—the every-day life of "Merry England" in the 16th Century. Now, one special note of that great epoch, which we call the Renaissance, was the awakening into extraordinary vitality of the individual capacities and characteristics of each nation that it touched. We might, therefore, naturally expect that in England, amongst other results, it would give birth to some new and striking development of dramatic art and genius; and everyone who knows anything of the history of English literature, knows that just such a development is exactly what we do find, holding a high place among the splendours of the age of Elizabeth.

It has been said that in every great age there are always to be found a group of eminent men who express what may be called the idea of the age, with more or less felicity, and amongst them one or two who express it perfectly. Thus Shakespeare shines not alone, but rather as a star of the first magnitude, whose brilliance hides a multitude of lesser lights. For the Elizabethan dramatists were many, and not a few of them men of true poetic gifts, and not without touches of greatness. Though scarcely any of their plays would bear being acted now, as Shakespeare's are, yet his and theirs all belong to the same school, and in their general framework, choice of subjects, and method of treatment, they resemble each other as much as they all *differ* both from the 17th Century drama of Corneille and Racine, and from the antique drama of the Greeks and Romans.

Where, then, did this so-called *Romantic* drama originate? (for in course of time a new name was found for the new school, which, in its first imperfect beginnings, seemed to a classical scholar like Sir Philip Sidney, a mere chaos of irregularity)—a drama which knows nothing of the unities, and presents to the imagination a series of what may be called *dramatic pictures*, in the course of which plot and characters develop themselves, somewhat after the fashion of a chronicle or history, and not at all after the fashion of the old-world idea of dramatic propriety.

Well! The question is not difficult to answer. It is quite certain, indeed it is one of the commonplaces of literary knowledge, that the English drama of the Elizabethan age—the drama of Shakespeare, Marlowe, and Ben Jonson—is the direct heir and representative of the old mysteries and miracle plays, and that every point in which our drama differs from the classical drama—and the difference is as great, and very similar in character, to the difference between Gothic architecture and Greek architecture—is distinctly traceable to that source.

It is to this literary interest, and to this alone—for the interest in the religious aspect of the plays is of much more recent origin—that we owe our present facilities for the study of the subject. For over 100 years—all through the period of rhymed couplets, of classical imitations, and of a debased immoral stage —Shakespeare had been entirely neglected and forgotten, except, indeed, by unscrupulous playwrights, who borrowed and caricatured his personages without the least danger of detection. But in 1733, 13,000 copies of Theobald's newly-published edition of Shakespeare were sold, and the revival of a relish for our great national poet soon led to a revived interest in the history of our national literature. Thomas Warton, Professor of Poetry at Oxford in 1756, published a history of English Poetry, which is, as far as I know, the very earliest work in which the old religious plays are brought forward as worthy of the attention of every student who wishes to understand something of the origin of the English drama. John Payne Collier, who was born in 1781, and published his History of Dramatic Poetry in 1834, goes still further, and gives, for the first time, a vivid and well-written account of the actual matter of our ancient mysteries, illustrated by a comparison of three of the most important sets that have been handed down to us in English, namely—the Chester, Coventry, and Townley mysteries. It is to the labour of the Shakespeare Societies, of a somewhat later date. that we owe the publication of the actual text of these plays, with admirable notes and introductions.

It seems probable that the words may have been copied out afresh every time that a new representation was given, and that the well-worn MS., which had already served its turn, was then lost or destroyed, for no very early MSS. seem to have been preserved. In the case of the Chester plays, and of these alone, we have a very interesting account of the actual manner of performance, from the pen of a certain Archdeacon Rogers, who was Archdeacon of Chester, Vicar of Gawsworth, and "Prebunde" of Chester Cathedral, just about 300 years ago, for he died in 1595, and he wrote his account of the plays some time subsequently to the year 1574, in which he witnessed their performance.

England, living (till 1588) in perpetual danger of a Spanish Invasion, and irritated, by Ridolfi Plots and Jesuit Conspiracies within her own borders, into a frenzy of intolerance, was just then yielding herself up to a current of feeling which tended to make Puritanism dominant in all the larger towns in the country. Chester was no exception, and we gather that the Rev. Robert Rogers (he does not seem to have been Archdeacon till 1581) was in complete sympathy with the strong Puritan party, which was gradually getting the upper hand both among the Cathedral

Clergy, and on the Town Council. Nevertheless, in spite of the extreme disapprobation with which all Puritans habitually regarded everything in the shape of "play-acting," Mr. Rogers could not help feeling very much interested in what he calls the "Anchant Customs" of Chester. As a good Protestant, he takes care to call them by the hardest possible names, and to speak of them in terms of contempt and depreciation, but at the same time he carefully noted down what he saw, and his description of the Chester Mysteries is the more valuable, because, as I have said, no other description exists, in the English language, of the manner in which these performances were given. (After his death his notes were copied out, and set in order, by his son, David Rogers, under the title of:—

"A Breviary, or some few Collectiones of the Cittie of Chester, gathered out of some fewe writers, and heare sett down and redused into these Chapters following—")

In speaking of the origin of "the Playes of Chester, called the Whitson Playes," Archdeacon Rogers says:—

"Heare note that these playes of Chester were the work of one Rondoll, a Monke of the Abbaye of S. Warburg in Chester, who redused the whole storye of the Bible into English stories in metter . . . and this Monke, in a good desire to do good, published the same. Then the first Mayor of Chester, Sir John Arnway, Knight, he caused the same to be played."

The "Banes," read before the plays were acted in 1600, repeat the same statement, which was evidently a tradition commonly believed in Chester during many generations. Sir John Arnway was Mayor of Chester towards the close of the 13th century, and as Fitzstephen, the biographer of Thomas â Becket, speaks of such performances as being frequently given in London as early as the 12th century, there is no great improbability in supposing that the Chester Plays may actually have been performed for the first time, as some say they were, in the year 1268. Only it is certain that the language of the copies that have come down to us is not 13th century English, and that if that was the language of the Randoll, who put the Bible stories into English metre, he cannot have lived till about 100 years later.

This brings us to another tradition. Attached to one copy of the Chester Plays is a vellum fly-leaf which says:—

"The Whitson Plays were made by one Randle Higginett, who was thrice at Rome before he could obtain leave of the Pope to have them in the English tongue."

Here, I think, is the key to the whole difficulty. Randle Higginett (whom Warton has tried, but I think on insufficient grounds, to identify with Ralph Higden, of the Polycronicon) did, indeed, "reduse" the Chester Plays into English metre; not, however, as a composer, but as a translator.

They were then originally performed in some other language? Yes, certainly. Plays of this kind were not native to our soil, they entered England from the Continent, during the period when Norman French was still dominant in English society, and the language used was always either French or Latin. There can be very little doubt that the Chester Mysteries were at one time performed in French, for even now we here and there come across untranslated bits, which, by the pens of many generations of copyists who were ignorant of that language, have, it is true, been robbed of all intelligible meaning, but are yet as unmistakably French as ever. We have, besides, to notice a remarkable similarity—sometimes it almost amounts to word for word—between some of the Chester Plays, and some of the corresponding plays in an old French collection known as the "Mystères du vieil Testament," which is much too exact and striking to be passed over as accidental.

It was, of course, not only in England that these kind of representations were popular; they were a common feature of mediæval life all over the Western world, and for a very long while a well-understood distinction was drawn between the two principal classes into which they were roughly divided. Those that were called miracles or miracle-plays represented incidents in the lives of the saints; martyrdoms most frequently.

"Hii ben disguised as tormentours in clerkes plei," is a satirical description of an absurd fashion in dress in the reign of Edward 2nd. In many instances the names of the composers of some of these pieces have been handed down to us, such as the miracle play of S. Catherine, by Geoffrey of Gorham, afterwards Abbot of S. Albans; the miracle play of S. Nicholas, by Hilarius, an Englishman, who was a disciple of the celebrated Abelard. But the name of mysteries was reserved for those plays only whose subjects were intended to illustrate the leading truths of the Christian religion, and here we find, amongst other great differences, that all the many sets of mysteries that have come down to us are apparently different arrangements of a single series of scriptural scenes and illustrations, which was, as it were, the common property of the Western Church. The selection is always the same, or very nearly so, and, whether the number of the plays be few or many, the *theme* of the entire series is always the same, and great, though unconscious dramatic art is shewn in the manner in which the central idea is continually impressed upon the beholder's mind. That central idea is Christ: the Saviour of mankind. Christ promised: Christ come: Christ crucified: Christ risen: Christ to come again. This is *the* subject, not only of the Chester Mysteries, but of all the other Mysteries, too, whether in England or on the Continent.

In the Chester Mysteries the series is arranged for a three day's performance, in which the first day sets forth the Creation of the World and the Fall of Man, followed by Old Testament types and foreshadowings of the coming Saviour, and concluding with the Saviour's birth, and his adoration by the Shepherds, and by the Wise Men from the East.

The great subject of the second day is the Passion and Resurrection of Christ, answering to the Passion Play at Ober-Ammergau, which is nothing else but the middle portion of the usual set of mediæval mysteries, very much reformed and purified. The scenes represented upon the third day set forth the beginning of the Christian Church, and the close of the present dispensation by the second advent of Christ. As at Ober-Ammergau, all the characters in the Passion Play (which is performed once in ten years) are sustained by the peasants and farmers and mechanics of the place itself, so also in Chester the Whitsun plays were acted by members of the various trade guilds, each guild making itself responsible for one particular play out of the entire set of 24. But here the resemblance ceases, for the Tyrolese Passion Play is acted in a simple but very perfect little temporary theatre, whereas each of the Chester plays had its own moveable stage, known as a pagiant; and it would appear from the following description that each play was acted two or three times over in the course of the day, in different parts of the city.

I cannot do better than read you a portion of Archdeacon Rogers's description :—

"The plays," he says, "were divided into 24 pagiantes or parts, according to the number of the Companyes of the Cittie, and every Companye brought forth their pagiant, which was the carriage or place that they played in. To see which playes there was great resorte, and also scafoldes and stages made in the streets in those places where they determined to play their pagiantes. And yarlye before these were played there was a man fitted for the purpose which did ride, as I take it, on S. George's day, through the Cittie, and there published the tyme and the matter of the playes in brief, which was called the Reading of the Banes. They were played upon Monday, Tuseday, and Wenesday, in Witson weeke. And they first began at the Abbaye Gates; and when the first pagiant was played at the Abbaye Gates, then it was wheeled from thence to the Pentice at the High Crosse before the Mayor, and before that was done the second came, and the first went into the Watergate Street, and from thence into the Bridge Street, and soe all, one after another, till all the pagiantes were played appointed for the first daye, and so likewise for the seconde and thirde daye. These pagiantes or carriages was a high place made like a howse with 2 rowmes, being open at the tope, the lower rowme they apparelled and dressed themselves, and in the higher rowme they played. . . . ."

(I interrupt the description to remark that we find from the parallel account of a German stage on wheels, quoted by Mr. Baring Gould, that when the play required that the action should be carried on in Earth, Heaven, or Hell, the lower room was made to serve for Hell, whilst the upper room was covered in, so as to form a third stage on the top, which might suitably represent Heaven. It will presently be seen that some similar arrangement must have been employed for the representation of some of the plays in the Chester Collection.)

. . . . . "And when they had done with one carriage in one place they wheeled the same from one street to another; first from the Abbaye Gate to the Pentice, then to Watergate Street, then to the Bridge Street through the lanes, and so to the Eastgate Street. And thus they came from one streete to another, keeping a direct order in every streete. For before the first carriage was gone, the second came, and so the third, and so orderly till the last was done, all in order, without any staying in any place, for worde being brought how every place was near done, they came, and made no place to tarry till the last was played. . . . ."

In the opening play, which is always the Fall of the Angels, we find ourselves at the very outset, brought in contact with that immense mass of legendary matter which, in the Middle Ages, was received with so much undoubting simplicity as an integral portion of the truth itself. The Fall of the Angels was, for some reason or other, a very favorite subject in England. The Anglo-Saxon poems, handed down to us as Caedmon's, dwell upon it at considerable length, and the curious 14th-century poem, known as the Cursor Mundi, which is supposed to give an account of the world from the Creation to the Day of Doom, begins with a long history of the Creation of the Angels, and declares how "the Angel that He wrought foremost . . . . and set him highest in the hall, as prince and sire over all, and for that he was fair and bright, Lucifer to name he hight" . . . rebelled against his Maker, and was "cast out of that high court." "From full high he fell full low," and can never obtain mercy, because he will never stoop to ask for it. And with him fell all his followers, though those that were less in guilt fell not so far as the others, but

"Some in the lift, some in the air,"

they dree their weird till the Day of Judgment; and these are the fays and fairies, the elves and gnomes, and water sprites, elemental spirits of mediæval superstition. It is strange to realize, as we must do as soon as we begin to consider the matter, that Milton's "Paradise Lost" is something very like the old Mystery of the Fall of the Angels translated into poetry; and, in this connection, it is interesting to remember how possible it is that Milton, in his youth, may have been present at perhaps more than one performance of the Whitsun plays at Chester, so that it may actually have been *here* that the never-to-be-forgotten impressions were received, which, in his days of blindness, came forth in such a glorious shape. For it is certain that Milton was on terms of intimate friendship with Henry Lawes, who set the songs in Comus to music, and himself acted the part of Thyrsis. Indeed, Comus was first printed because the pen of Henry Lawes was tired out with repeated copyings of that "lovely and much desired" poem. Now, Comus was acted at Ludlow in 1634, and Ludlow brings us very near to Chester. Not only that, but the Lawes family were directly connected with Chester, and William Lawes, the brother of Henry, was one of the victims of the siege in 1645.

But if Milton did indeed "found some of his most magnificent pictures on the rude groundwork of the mysteries," the *poetry* is all his own. All through these ancient plays there is scarcely a line which fixes itself in the memory as deserving to be retained. What we do retain is the impression of a remarkably vivid and beautiful series of pictures, full of poetic touches, and of moving incidents; full also of much that is grotesque, and sometimes coarse even to grossness.

Yet, in the first instance, there can be no doubt that they were devised (to use Archdeacon Rogers's expression) "in a good desire to do good." There can be no doubt, either, that they *did* spread abroad among an ignorant people a general knowledge of the leading outlines of the Christian faith. They were at first acted in churches, by monks, and by the younger clergy, and partook of the character of a divine service. But, before very long, through the church door out they slipped into the streets and commons, followed, as ever, by crowds of eager spectators; and then human nature asserted itself, and insisted on being allowed to laugh. And upon this followed incongruities which soon caused the stricter sort of people to lift up their hands in condemnation. There is a well-known quotation from a popular religious book in the 13th century—Wm. de Wadington's Manuel des Pêchés—which sternly rebukes "the open folly called miracles, contrived by foolish clerics," and complains that, though this is against the law, they even make their sin greater by disguising themselves with masks. Such representations (he says) ought never to be given, except to set forth "chastely," within the walls of holy church, and in service time, the mysteries of the New Testament—How the Son of God was laid in the Sepulchre—How He rose from the dead—to move people to devotion. But to hold wild gatherings in the open streets! Readily, indeed, do the fools run together, and each pretends a pious intention, and says he does it for the honour of God.

"Croire ne le dever pur rien."

"Do not believe it for anything," he exhorts, in his rude Norman French.

Yet, in spite of these severe remarks, it must not for a moment be supposed that anyone desired, or would even have endured, the slightest approach to ridicule of holy things. But to make fun of the Devil seemed not only not wrong, but even a kind of virtue; and the same freedom was judged to be quite allowable in the case of a wicked man like King Herod, who was always expected to strut and swagger about the stage in the most outrageous manner. Chaucer tells us that Jolly Absolom, the Parish Clerk, used to take this character,

"Sometimes to show his lightness and maistery
He playéd Herod on a scaffold high."

And I have seen a picture of a French mystery in which Herod is amusing the audience by balancing his sceptre on his hand. And then there were some of the minor personages, mentioned, but not named, in Holy Writ, who became, as it were, the stock comic characters. Of these, the most popular was Noah's wife, who was expected to show the utmost reluctance to enter the Ark. In the Chester Mysteries she refuses to leave her "good gossips," with whom she sits drinking and singing the good gossip's song, whilst

> "The flood comes flitting in full fast,"

until she is carried into the Ark by main force, by Shem and Japhet. Noah tries to conciliate her by saying—

> "Welcome, wife, into this boat,"

but receives a blow in the face in return, with the words—

> "Have thou this for thy note."

. . . .

And then he shuts the window of the Ark, and there is silence for a little space; after which we hear the Voice of God proclaiming the Covenant of the Rainbow, and the play, which was acted by "the good simple Water-leaders and Drawers of Dee," concludes.

"Finis. Deo Gratis. Per me, Geo. Bellin, 1592," is the signature; and, as at the end of every other play in the set, the copyist adds the words—

> "Come, Lord Jesu, come quickly."

But the favourite play in the whole series, and the one in which the extraordinary alternation of farce with solemnity is the most remarkable, is "the Shepherds' Play." The Shepherds are not named in Scripture, and therefore it was, as has been said, considered permissible to invent both names and characters, and in every one of the Mystery plays the pageant De Pastoribus opens with some rude scene of rustic humour. In the Chester play the three Shepherds, and their boy Trowle, are simple Cheshire and Lancashire folk. The First Shepherd begins by declaring, in the homeliest way, how well he understands his business:—

> "From comely Conway unto Clyde
> A better shepherd on no side,
> No yearthly man may have."

The Third Shepherd is deaf, and may not well hear.

> "Call him Tudde, Tibbe's son,
> Then will the Shrewe come,
> For in good faith, it is his wonne
> To love his dame's (mother's) name,"

says the Primus Pastor, and, after some shouting, Tudde, the son of Tibbe, appears, and excuses his delay by saying that he has had

> "To seithe salve for our sheep."

He knows every point that belongs to his craft, he says, and proceeds to name all the herbs of which the salve is made. Also, lest his wife should discover what he has been doing, he observes that he has been scouring the old pan 'with great gravel and grit,' for (he adds) it is not unknown to good men that there *are* matters in which every husband has to give in to his wife.

Then each man lays forth what he has left of his "livery," *i.e.*, of the supply of food with which he set out from home, they "shake out their satchells," and solace themselves by supping together; and then they bethink them of the lad Trowle, who is keeping their flocks while they eat, and a horn is blown to summon him where he lies among his sheep with his good dog Dottinoule—a lazy shepherd lad, indeed, for he boasts—

> "If any man come me by,
> And would know which way were best,
> My leg I lift up as I lie,
> And point him the path, east or west."

But this lazy lad, who "would not rise for King nor Duke," and gives his masters the sauciest answers when they offer him the remains of their food, proves himself stronger than all three when a wrestling match is proposed, and throws them each in turn.

Primus Pastor may well say:—

> "Tho' we be weary no wonder,
> What between wrestling and walking."

And then, as they sit down to rest, the star appears—for the Angelic light is conceived of as a star—the metre changes, and so does the entire character of the scene. The shepherds fall on their knees, and pray "to the True Trinity" to be taught why the light is sent; and then the Angels sing *Gloria in Excelsis*.

It is very remarkable to notice that, as a matter of course, it is taken for granted that the Angels use the Latin language.

> "What song was this, say ye,
> That they sang to us all three. . . .
> It was glore—glore—with a glye,
> It was neither more nor less."

"What song was this, say ye, that they sang to us?" asks the Third Shepherd.

> "Nay," (says Trowle), "it was glory, glory, glorious,
> Methinks that song ran over the house,
> A seemly man he was, and curyous,
> But soon away he was. . . . ."

"It was glory, glory, with a glo," breaks in the First Shepherd. "And much of *Celsis* was there, too."

Thus, word by word, they spell out the heavenly message.

"Much he spoke of glass," says one.

"Nay, it was neither glass nor glye," replies another.

"Will ye hear how he sang *Celsis*?" asks the Third Shepherd.

"And after of *Pax or Peace*, he piped," affirms the first.

"Yea," Trowle, "and he sang more too; he sang also of *a Deo*. Methought it healed my harte. . . . ."

And then, as if to relieve the strain, the Second Shepherd proposes "a merry song us to solace." The directions are:

> "Sing troly, loly, loly, loe!"

And Trowle says :—

> " Sing we now, let's see,
> Some song will I assaye;
> All men now sing after me,
> For music of me learn you may."

And afterwards they wend forth to Bethlehem, and when they see Mary, and "Jesus Christ lapped in hay," they kneel down to worship and give thanks, and kiss the manger and the swaddling clothes, and offer grotesque rustic gifts.

> " Lo ! I bring thee a bell !
> Lo ! I bring thee a flaggett,
> And thereby a spoon,
> To eat thy pottage withal at noon."

Trowle offers a pair of his wife's old hose, an offering which is sometimes quoted as an instance of intentional absurdity, yet there is nothing to ridicule in Trowle's simple declaration that he has nothing else to give

> . . . " That is worth anything at all,
> But my good heart while I live,
> And my prayers till death do me call."

After this, quite irrelevantly, four boys come in, and they bring offerings, too, and then the First Shepherd solemnly bids farewell to the Lord's Mother, and the Second Shepherd says, " Brethren, let us all three, singing, walk homewards."

It is characteristic of the age, to which these performances belong, that they all determine to keep sheep no more. Trowle counsels the others to agree " for their misdeeds amends to make," as he, for one, intends to do. " Shepherd's craft I now forsake," he declares. He will betake himself wholly " to that childe," and find an " anker " or hermitage near by, where he may watch and wait in his prayers.

" Sheep will I keep none now," says the Third Shepherd; he and the Second Shepherd determine to go forth and " preach in every place."

" This world I wholly refuse," says the First Shepherd. Barefoot on his feet, he will go into the wilderness to bemoan his sins.

Deeply as the mediæval mind did sometimes read into the depths of the Gospel story, they do not seem to have caught the least hint of any significance in the visions being sent to simple labouring men, whose watch-keeping by night was the proper work of their humble calling.

I would mention that the Shepherd's Play is succeeded by that of the three Kings. I am unable to notice the mass of legend that has in this case grown up about the narrative of the Evangelist; but before I quit the subject of the first day's performances, I must at least devote a few words to the very peculiar scene of Octavian and the Sibyl. It occurs in the midst of the sixth play, which bears the general title of " The Salutation and the Nativity," and it is, in the first instance, an amplification of the statement of the Evangelist, that "there went forth a decree from Cæsar Augustus that all the world should be taxed." A personage called a Nuntius appears and proclaims:—

. . . "Make room, lordings, and give us way,
And let Octavian come and play,
And Sibyl the Sage that well fare may
To tell you of prophesy.
That Lord that died on Good Friday,
He save you all both night and day,
Farewell, lordings, I go my way,
I may no longer abide." . . . .

And then Octavian enters, and in a long speech boasts of his own greatness, and the greatness of the Roman Empire. And in this speech occur thirteen lines of French, such as have been already alluded to, of which the meaning has long been lost.

"Segurrs tous se asmeles," they begin, and we can just guess that this was once "Seigneurs tous ici assemblés," but the rest is quite unintelligible. The speech, however, is lengthy enough without these thirteen lines.

"Since I was soveraine (he says) war clean can cease,
And thoro' this world now is peace,
For so dread a duke sat never on dais,
In Rome, that you may trust."

Therefore, to prove his might and power, he will send about and see "how many heads he has," and king, clerke, knight, or knave, each man one penny shall pay, and this game shall begin in Judœa, because the folk of the Jewes are "in the medest of the world!" His bedell, who, oddly enough, swears by Mahound, hastens forth to do his bidding, and then the senators of Rome appear, to tell him they are sent from all Rome to offer to honour him as a god

Octavian hesitates:—

. . . "Folly it were (he says) by many a waye,
Seeing I must die I wot not what day, . . .
Neither of iron, tree, nor stone,
Am I not wrought ye wot each one,
And of my life most part is gone." . . .

And there is no godhead, this he knows, without eternity, for

. . . "Godhead asks in al thinge
Tyme that hath no begininge,
Nor never shall have ending,
And none of this have I." . . .

Nevertheless, let them ask Sybil the Sage—

. . . "Her that has grace for to see
Things that afterwards shall be." . . .

So Sibyl the Sage appears, and he asks her whether there shall ever be any earthly king greater than himself. "Yea, Sir," she answers at once,

. . . "A barn is born bliss to bring,"

the which had never beginning, nor never shall have end. And on the Emperor's further enquiries, she utters a distinct prophecy of Jesus Christ. The arrival of Joseph and Mary, and the Birth of the Holy Child is next represented, and then (after a long discourse by an Expositor) the Sibyl and the Emperor reappear, and the Sibyl shows him in a vision "a maiden bright," with a young child in her arms, in whom Octavian recognizes the true divine King.

> "Honour will I that sweet wight,
> For that reverence is most right.
> Should I be God? Nay, witterly,
> Great wrong I wiste it were."

And so he turns to the Senators, and wholly refuses the worship they offer, and bids them rather "worship this child" with full harte all they can. . . . An Expositor sums up the matter by declaring:—

> . . . "Lordings, that this is vrai
> By very sign know ye maie,
> For in Rome, in good faye,
> There, as these things were seene,
> Was built a church in noble array,
> In worship of Mary, that sweet maye,
> That yet lasteth unto this daye,
> As all men know that there hath been."

And with this strange mixture of history and fable, the first day's performances seem to have closed.

Archdeacon Rogers tells us that the nine pageants played on the second day opened with the slaying of the children by Herod; but, after that popular, but horrible series of incidents, which ends with the death of Herod, who is carried off by a demon, no grotesque interlude, no rude by-play, mars the ever-deepening solemnity and pathos with which the sacred story of the Passion is gradually unfolded. Not, however, that there is no intermixture of legend. Thus, for instance, when the Pharisees bring the woman taken in adultery to Jesus, and He says, "let him that is without sin among you cast the first stone," and, stooping down, writes on the ground, "each man believes that he sees his own sins written down." "No longer dare I here be for dread of worldly shame," says one. "Alas! that I were away far behind France," cries another.

And the pageant that immediately follows the Crucifixion is that so-called "Harrowing of Hell," which invariably had its place in every collection of mysteries. For no tradition had a firmer hold on the mind of mediæval Europe, than that which taught that none but Enoch and Elias had a place in paradise until Christ died upon the cross, and, descending into hell, fetched thence our first parents, with "Abel, their child, and Noah, righteous man," and "Moses, law-giver for faith approved," the patriarch Abraham and King David—"Israel with his sire and with his sons"—"and others many more." Readers of Dante will remember the passage in the 4th Canto.

The most exceptional play in the Chester Mysteries is the last but one of the entire series—the 6th play on the 3rd day—

which represented the Coming of Antichrist. As far as I know, it is found nowhere else except in one early Latin collection, though the legend on which it was founded is a very well-known one. Antichrist convinces the Kings of the Earth by raising the dead, but is confounded by Enoch and Elias, whom he is, nevertheless, able to slay, but is himself slain by the Archangel Michael, and his soul carried off by demons, whilst Enoch and Elias are recalled to life and taken to heaven's bliss by Michael. "Long," he says, "have you been dwelling in Paradise, but to Heaven, where Himself is, now shall you go with me."

The next play, which is the 24th and last, bears the awful title of "Doomsday," and very awful and terrible it is. At the very end the Four Evangelists appear, and bear testimony that they have written and taught the truth concerning Christ's redemption, and therefore "excusation none there is," if the witness was unheeded. In the 22nd play, of which the subject is the Descent of the Holy Spirit, there is a very quaint scene, in which the Twelve Apostles give utterance each in turn to a kind of paraphrase of the Twelve Articles of the Apostles' Creed, the corresponding words of the Creed itself being recited in Latin between each verse, S. Peter beginning with:

"I believe in God omnipotent,
That made earth and firmament,
With stedfast harte and true intent;
And he is my comforte."

And the newly-chosen S. Matthias ending with:

"I believe, as all we may,
Everlasting life after my day,
In heaven to have ever and aye,
And so overcome the devil."

After which, S. Peter proposes that they shall all

"Goe each one to divers countreye,
And preach to shier and to cittie
The Faith, as Christ us bade." . . .

It seems to be pretty certain that the Chester Plays were not acted annually, though we do not know whether the interval at which the performances took place were regular or irregular. In the years when (to use the quaint old phrase) the plays "went not," there was a grand procession of the Trade Guilds of Chester, dating, perhaps, from even earlier times than the mysteries themselves, which included a great many strange devices, and was known as the Midsummer Show.

All these ancient customs, but especially the Whitson Plays, were the delight and pride of the citizens of Chester, though it is possible, and even probable, that there may always have been some who disapproved of them, and would have liked to see them put down. Thus, in the 14th and 15th centuries, we find the followers of Wiclif crying out against the popular religious drama, and when we understand how very large was the intermixture of legendary matter, we can readily understand their feelings. At the Reformation the Puritan party openly denounced the "Popish Plays," as they usually called them, as altogether abominable—a profanation of the sacred Scriptures themselves. For, to the Puritans, every kind of dramatic representation partook of the nature of sin, and, as religious feeling in England became increasingly Puritan in character, we find traces of a constant and persevering endeavour to get rid of them altogether.

Archdeacon Rogers concludes his account of them by saying:— . . . . . "These Whitson Playes were played in Chester Anno Domini 1574, Sr John Savage, Kt., being Mayor of Chester, ... and (he continues) we have all cause to power out our prayers before God, that neither wee, nor our posterities after us, may never see the like Abomination of Desolation, with such a Clowde of Ignorance to defyle with so highe a hand the sacred Scriptures of God. But of the mercy of God for the tyme of our Ignorance he regardes it not: and thus much in brief of the Whitsun Playes." . . .

"For," he says, elsewhere, "if I should here recite the whole storye of these playes it would be too tedious for this breviary; *as, also, they being nothing profitable to any use, except it be to shew the Ignorance of our Forefathers*, and to make us, their offspring, inexcusable before God, that have the true and sincere words of the Gospell, if we apprehende not the same in our life and practice to the eternal glorie of our God, and the salvation and comforte of our own soules."

But the "Popish Plays" died hard. It would seem, from a list of the Mayors and Sheriffs of Chester, published by Daniel King, in 1656, that they were actually played again in 1575, but on the first Monday, Tuesday, and Wednesday, after Midsummer Day, instead of at Whitsuntide, and that Sir John Savage, who was still Mayor, caused them to be played in defiance of an inhibition from the Archbishop of York, and was, therefore, served by a "pursevant" from York, the very same day that a new Mayor was elected, just as a Mr. Hankey had been, for the like contempt, when *he* was Mayor in 1572. And "divers others of the Citizens and Players," says Daniel King, "were troubled for the same matter."

It is clear that they were again acted in 1600, for we have a copy of the Banes, specially prepared for that occasion, in which it is admitted that the Plays do indeed contain

"Some things not warranted by Holy Writ," . . .

but,

"As all that see them shall most welcome be,
So all that hear them wee most humbly praye
Not to compare this matter or storye
With the age or tyme wherein we presently staye,
But in the tyme of ignorance, wherin we did stray.
If the same be liking to the commons all,
Then our desier is to satisfy, for that is all our game.

> If no matter nor show thereof specyall,
> Doe not please, but mislike the most of the trayne,
> Goe back, I say, to that first tyme again;
> Then you shall find the fyne witt at this day abounding,
> At that day, and that age, had very small being."

That they were acted again a few years later is proved by the existence of a MS. copy, bearing the date 1607; but after the siege of Chester, and the complete predominance of Puritanism during the Civil War, we do not hear of them again. There was, indeed, some poor attempt made at the Restoration to make new giants, and to revive the Midsummer Show; but the broken tradition of the Mysteries was not so easily to be repaired, and the very memory of what they had been like was soon buried under the dust of many generations.

If, indeed, the recollection of them could be "nothing profitable but to show the ignorance of our forefathers," it would be hardly worth while to try to clear away that dust, and bring them once more forth to the light; but, indeed, they are interesting in so many ways, and in so many different points of view, that I find some difficulty in limiting myself to the few concluding remarks, which is all that I shall now do.

1. In the first place, we cannot but observe that, with all their faults, they did keep vividly before the mind of the English nation the leading outlines of Christian teaching, and that in the historical form suggested by the Apostles' Creed. Much that was legendary, coarse, incongruous, was there also, no doubt; but *that* was there above all.

2. What a wonderful educative force lay in the fact that they were acted by the people of Chester themselves! It was not as mere spectators that the Chester public assisted at these Mysteries No: the performance was a local work of art, in which the entire town had a personal share. They believed, with just pride, that, search England throughout, "None had the like, nor the like dose sett out."

This, indeed, was the characteristic of the old English drama. There were no professional actors, and no theatres. "It hath not been used," wrote the Corporation of London, in 1575—(in reply to a complaint on the part of the players that their refusal to allow them to exercise their art within the city of London was taking the bread out of their mouths)—"nor thought meet, heretofore, that players should make their living on the art of playing; but men for their living, using other honest and lawful arts, or retained in honest services, have, by companies, learnt some interludes, for some encrease to their profitts by other men's pleasures in vacant time of recreation." . . . .

The first theatre came into being between 1575 and 1580, nor can we regret a change that gave us Shakespeare; but the audience, for which Shakespeare wrote, was an audience trained to true dramatic appreciation by their perfect familiarity with acting as an amusement, and their instinctive readiness to respond to the demand that a good play makes upon the imagination.

3. The old religious drama created in the popular mind a high ideal of the true use and purpose of dramatic art; namely, to present to the imagination a living picture of the realities of life and feeling.

Since the Puritans, rooting out both wheat and tares together in the eagerness of their zeal, made the theatre over to the enemy of mankind, it has seldom, *at its best*, aimed higher than mere entertainment. Not so the old Mysteries; not so the Moralities; not so the Elizabethan drama. Some relief, in the shape of farce or comedy, the people, indeed, demanded, but the main purpose was often entirely serious, and the spectators, that were so ready to laugh, were equally ready to respond to the appeal addressed to the higher nature. Shakespeare's plays would hardly have been written now. The audience then expected the stage to treat of that which they really cared for, and that first and foremost had been religion; and then, a little later, came the history and politics of their native country. There were farcical interludes, of course, but many examples might be given to show that, among a rude people, farcical interludes did not produce an impatience of everything that was not farce. It was not farce, but controversy, that introduced into the religious plays that element of heartless irreverence which slays the very soul of faith.

Yet I, for my part, am inclined to think that it was well that the old mystery plays, whether in Chester or elsewhere, did come to an end in England in the 17th century. It is true that the Passion Play at Ober-Ammergau is, as I have already hinted, nothing else but a set of Scriptural Mysteries—just such as the Chester Mysteries—purified from legend and coarseness, and set forth in an almost ideally perfect manner once in ten years. But that such a performance would jar upon many of our best instincts almost anywhere but in a remote and secluded mountain village is certain. What it might become elsewhere may be gathered from the impression left upon an English mind by the vulgar spectacles frequently to be seen in Spain or in Belgium. As carefully guarded attempts in that direction, I may, however, mention the wonderful "morality," if I may so call it, of the "Pilgrim's Progress," carried out with so much success by George Macdonald and his family; and the following account of a remarkable set of Scriptural pictures, or tableaux-vivants, grouped from scenes in the Ober-Ammergau play, and given by the inhabitants of a village in Worcestershire, appeared in the *Daily News* on January 9th, 1882:—

"The unusually quiet village of Rouslench, near Pershore, Worcestershire, has, during the past week, been the scene of an extraordinary miracle play, which was suggested to the

Rector, the Rev. Mr. Chafey, by the Passion Play at Ober-Ammergau. The interest in the play grew daily. . . . . . In style the piece had been made to imitate, as far as possible, the Great Passion Play, suitable scenery and gorgeous dresses having been obtained at great cost. The peformance consisted of a series of tableaux-vivants, representing various events in the life of Christ. There were exactly 50 persons taking part in the performance, their ages ranging from four years to 82 years, the Rector taking a leading character from time to time. An explanation was given of the successive tableaux, and selections of music were played during the performance from the Elijah and from the Messiah."

But these are exceptions and I do not desire to see such attempts become common. What I do regret is the disappearance of that which was next, after the Moralities, the earliest successor to the religious drama, the old Chronicle Play, wherein the events and characters of English history were dealt with in the same simple pictorial way as the history of the Bible had been in the religious plays; and now the importance of healthful and innocent recreation is being realized, as it never was realized before, I am not without hope that something of this kind may actually be revived before long, and prove a very great success. We must remember that it is upon the old Chronicle plays, simple and rude as they were, that Shakespeare's magnificent historical dramas are founded.

I must not, however, pursue this train of thought, for I fear I have already trespassed rather longer than I ought to have done upon your patience. I can only plead in excuse the difficulty I have experienced in selecting from the abundance of material at my disposal, and, in conclusion, express a hope that I may have succeeded in imparting to my paper at least *some* touches of the interest that I myself feel in the subject upon which I have had the honour of addressing you.

Notes on the Natural History of the District, from 1879 to 1893.

EDITED BY ALFRED O. WALKER, F.L.S.

Note on the Squirrel.

THIS, the most beautiful and graceful of all our wild animals, is frequently accused of biting off the leading shoot of Fir trees, and persecuted accordingly. I have a good many Conifers of various kinds in my grounds, and, I should guess, almost as many Squirrels. At any rate, it is certain that if each Squirrel bit off only one leading shoot in each year, I should not have an unmutilated Fir tree in the place; whereas, on the contrary, it would require a long and careful search to find a single tree so disfigured! It is well known that Conifers sometimes lose their "leaders" from other causes in places where there are no Squirrels.

A. O. W.

Occurrence of Dolphins *(Dolphinus delphis, L.)* at Colwyn Bay.

On October 15th, 1874, a "school" of Dolphins passed through Colwyn Bay, near the shore. As usual with this species, they were very playful, not only rolling like Porpoises, but sometimes throwing themselves quite out of the water. They were easily distinguished from Porpoises by their blowing or spouting, which Porpoises cannot do. The station-master at Colwyn Bay (then Colwyn) Station, asked me if I had observed the Sprats and Herrings jumping out of the water in front of the "Porpoises" noses! This was his interpretation of the spouting!

A. O. W.

Habits of Rooks.

Rooks, which had been greatly reduced in numbers by the severe winters of 1879 to 1881, had again become numerous in 1884, and the little colony at the Lead Works, deserted since 1880, was again established. Probably it is only an outlier of the Rookery at Dee Hills (about 300 yards distant), and is only occupied when the latter is full. It is curious that whenever it is re-established (and I have known this to happen twice, with an interval of three or four years in each case) the Rooks always return to the same tree—a dilapidated Poplar *(Populus nigra)*, overhanging a chamber used for drying white lead, the ventilator of which is underneath the nests; and this although there are several large Elm trees *(Ulmus campestris)* in the garden. As this tree was in full view of my dressing-room window, I was able to watch the operations of the birds. One pair, probably a young couple, were many days before they even got a foundation to their nest. They would seem to have selected an unsuitable fork, and partly owing to the difficulty of construction arising from this cause, and partly from the fact that as soon as they flew away to fetch more building material, the other Rooks stole their "twigs," it seemed as though they would never get beyond the first few twigs. At last, on March 20th, when they had been engaged over a fortnight, a gale blew down their nest and another, and so frightened all the Rooks that they left their work for a few days. At last, however, all the nests were completed.

A. O. W.

Note on Sea Gulls.

On October 20th, 1878, I observed a long scattered line of Gulls, all flying from the Little Orme to Colwyn Bay, where they alighted on the sea close to the shore. I then noticed an immense shoal of "Whitebait," or young Herrings, extending along the shore as far as the eye could reach, and forming a dark band in the water so close to the edge that many were thrown on shore, and a good sized dish of them was secured in this way. The Gulls soon gorged themselves, and remained sitting on the water ready for another meal. It would be interesting to know how the information as to the presence of the shoal was communicated to the Gulls on the Little Orme!

A. O. W.

The Birds of a Town Garden, 1884.

Our gardens, forming part of a wide open space between 56—60, Watergate Street and Matthew Henry's Chapel, and containing many large trees—Ash, Elm, Birch, Sycamore, with Laburnum, Lilac, &c.—are frequented not only by Sparrows, Jackdaws, and Starlings, but (more rarely) by Redbreasts, Blue Tits, and Blackbirds. This last summer and the preceding (of 1883) we have been visited by *one* of the Woodwrens; I suspect the Chiff-chaff, because that bird (betrayed unmistakably by its note, though feeble) was seen there twice, with a long interval, *very* late in the season (I believe once in *November*) a good many years ago. In 1883, they came in two batches, first three and then two, the latter being at once persecuted by the former; but the five remained.

This last summer they came while we were away, and soon disappeared, probably because the *Heracleum ponticum*, which supplied them with *Aphides*, was destroyed early by caterpillars.

J. PRICE.

Effects of the Winter 1878-79 on the Throstle.

After the severe weather of this winter, which began on December 9th and continued with few breaks till far into the spring, Throstles *(Turdus musicus)* became remarkably scarce.

The following is an extract from my "Review of 1879," read before the Zoological Section, November 13th, 1879:—"Never "before have I known a winter in which on every mild day after "Christmas the Throstle failed to sing in our garden (at Chester.) "Last winter I heard one sing but once, on January 30th, and "never again till April 30th! And wherever I have been in "different parts of England, I have observed how rare it was to "hear the song of the Throstle." Perhaps in consequence of this scarcity, slugs and snails were extraordinarily abundant in the summer of 1879. Severe winters continued till they culminated in the tremendous frost of January 16th, 1881, so that it was not until 1884 that the Throstles had materially increased in numbers, when, however, they seemed to be as common as they were before 1879. Blackbirds, a bolder and hardier bird than the Throstle, were much less reduced in number.

A. O. W.

Birds Flying Westward in Snowstorms.

My lamented friend, Mr. J. Price, writes: "Always, during "heavy falls of snow, large flocks of Larks and Starlings kept "passing Pwllycrochan (Colwyn Bay) westward, all day long. "Query—for Anglesea or Ireland?" I observed the same phenomenon, also at Colwyn Bay, on December 5th, 1892, as shown in the annexed extract from my Diary:—"Another "horrible day" (the 4th had been similar): "heavy showers of "snow and hail, with strong wind from N.W. to N.: ground "covered with snow slush. At 10-30 a.m. saw immense num"bers of birds—Peewits, Sea Gulls, Rooks, and innumerable "small birds apparently of the Thrush family, all flying due W.— "not along the coast. They were from 20 to 100 yards above "the earth. On going home at 4-30, the trees by the drive were "filled with hundreds of birds, which in the dusk looked like "Redwings." The drive is along the slope of a steep and high hill facing E.S.E., and the trees out of which the birds flew when I passed were *Cupressus macrocarpa*, and other Conifers. The migrating birds seem to have struck this hill late in the afternoon, and decided to avail themselves of the shelter. They had all disappeared next morning. What is perplexing about the westerly flight is that, unless the birds stopped in the Conway valley, their line of flight would take them into the heart of the Carnarvonshire mountains, where they would be worse off than ever! I noticed the same phenomenon some years ago at Bournemouth.

A. O. W.

Hooper Swans (*Cygnus musicus.*)

On the 12th of January, 1871, I was walking down the valley between Holywell and Bagillt when I was struck by a singular sound which at first I could not assign to any part of the surrounding country. At last, I happened to look upwards and there, against a blue sky and with the low winter sun shining full on them, was a glorious string of thirty wild Swans. They were flying, as usual, in single file, and in the form of a long-shanked fish-hook with the shank end foremost, and calling to each other as they flew towards the Dee. It was a sight never to be forgotten.

A. O. W.

NOTES ON STARLINGS, &c.

Returning from a walk to Eccleston on the 13th November, 1881, at 4 p.m., I observed two enormous flocks of Starlings flying over from the direction of the Dee Estuary and shaping their course towards their roosting place, which I afterwards learned to be Cotton Gorse. By counting several detached parties I estimated there would be at least 2000 Starlings in each flock. Although they flew higher than the tall trees the sound of their wings made a very loud rushing noise like a brisk wind blowing through trees in leaf, and they also cast quite a dark shadow on the earth as they passed along. I have frequently been told that they roost in very large numbers in the Huntington Woods, but their favourite haunt is apparently "Cotton Gorse," near the Gowy. Where can they have been feeding? and what on? were questions I have not been able to solve, and should be glad to have information on. One pair has nested in the ivy here (Eaton Road) for the past three seasons, and we have been greatly interested in their habits and beauty. They have always reared some young which have flown, but there has each season been considerable mortality among the young, dead callow young ones of various ages being often cast from the nest to the ground in such a state as to suggest they had died from some disease in the nest, and then thrown out by the parent birds. Their boldness and usefulness also, during the nesting season, are very striking. A young cat we had would often climb an apple tree about eight yards from the nest and would immediately be attacked by one or both of the old birds who would flit from tip to tip of the branches just out of the cat's reach and utter all the while the loudest cries I ever heard them make, until at last puss would become so bewildered she would cry out and get away as fast as she could, and the Starlings would continue the attack as long as she remained in sight. But if Starlings are useful in destroying grubs when they have young, they take a pretty liberal toll for doing so when the fruit is ripe. When cherries are ripe they seem to be converted for the while into eating machines, and go on, if undisturbed, eating all day long; *any* succulent fruit seems to suit their taste. I have two Yews and two Mountain Ashes in my garden. Each year I have noticed that the Starlings *clear* the fruit off both kinds of trees within two or three days at the most after they have found it is ripe and fit to eat. But for all their frugivorous habits I think they are most useful birds and most interesting in habits. Their chatter and ventriloquism when sunning themselves near the window on a bright spring morning is as entertaining as their plumage is beautiful.

Of Sparrows, the ivy harbours legion. This spring they hardly touched primroses and not many crocuses, but in previous years they have destroyed both. Just at present an *all* white sparrow is reported here, which we hope to get for the Museum.

The first *Swallows*, six in number, we saw flying over on the 26th April. They were apparently so tired with their flight that they seemed to get along only by great exertion. They flew at once to their old nesting place (some buildings about 300 yards from the house) and did not appear on the wing again for a week.

During a stay at Bull Bay (on the North Coast of Anglesea) at the end of August and early part of September, we saw the Lobster pots drawn up for the winter. They were covered with beautiful examples of the Rosy Feather Star (*Antedon rosea*), varying in colour from yellow to deep red.

Is not the singular minute *Annelid* with only two tentacles, which lines hollows of limestone all round the Ormes and at Llandulas, *Spio setieornis ?* I have often wondered over this little creature and tried to scrape or get it from the holes for examination, but it seems to me to actually perforate a tube into the limestone into which it withdraws on the least alarm. And the ragged edges of the cavities seem to indicate rapid erosion, and the probability that they are due to the burrowing of *Spio*. No doubt you have often seen the little worm with its two long thread-like *setæ* lining miniature pools at the places named.

J. D. SIDDALL.

Note on Starlings in the above.

It is curious, that although Starlings are extremely common about my house and garden at Colwyn Bay, I have never seen one taking, or even trying to take, any kind of fruit. On the other hand, Blackbirds, which are also very abundant, clear off every sort of fruit that is not protected from them, and if a hole can be found in the covering net they are certain to find it out and take advantage of it. Possibly, the Blackbirds, which are very pugnacious, drive the Starlings away as they certainly do the Throstles, when the birds are fed in winter. As the latter are in every way superior to Blackbirds—in their much longer duration of song, in their destruction of snails, and their much smaller "frugivoracity"—it is clear that one may easily have too many Blackbirds.

A. O. W.

Habits of *Gobius minutus* (Small Goby.)

This little fish, which is common in the Estuary of the Dee, lays its eggs in the inside of the shell of any large bivalve mollusc, such as the common Mussel (*Mytilus edulis*), or Clam (*Mya arenaria.*) It then (or possibly before) half buries the shell in the sand, the ova being in the unburied half, which may be seen sticking up at the bottom of shallow pools at low water, the Goby lying with its body under the shell, and its head looking out. My friend, Mr. Allan B. Dick (to whom I am indebted for the fact), observing this, turned the shell up, whereupon a number of shrimps at once "went for" the eggs which were now exposed to view; the Goby drove them away, and then set to work, by digging with its head under one end of the shell, to replace it in its former position, which after some time and labour it succeeded in doing, when it resumed its place like a sentinel in his box.

A. O. W.

Wasp eating Wasp Larvæ.

On September 10th, 1880, I noticed a worker Wasp *(Vespa sp.)* flying out of the hole of a nest which had been destroyed by pouring in gas tar. The Wasp had a wasp-grub in its mouth, which I thought she was rescuing. She alighted with it close to me, and I boxed both. On opening the box a few hours later the grub had disappeared, and must have been eaten by its unnatural relative, which, however, may have been of a different species.

A. O. W.

Queen Wasps and Cotoneaster Scale.

In the beginning of June, *Cotoneaster microphylla* is very attractive to Queen Wasps of all the species that occur in our district. They do not visit the flowers, but on alighting on the shrub (which covers a sunny bank by my drive at Colwyn Bay), descend at once among the stems. If closely watched they will be seen to run rapidly over those stems and leaves where the Cotoneaster scale (*Secanium ribis*) is abundant. In order to ascertain what the attraction was, I enclosed a Queen in a large wide-mouthed bottle, containing some twigs of Cotoneaster covered with scale. As soon as she had become accustomed to confinement, which only took a few minutes, she began to travel all over the stems and leaves, and by watching her through a lens I could see her tongue licking up the secretions from the scale off them as she moved. As at this time of the year the Wasp's Nest, even if formed, very rarely has any workers hatched, the destruction of a Queen means the prevention of a nest, and a boy stationed by a bank of Cotoneaster with a ring net of muslin, would soon destroy Queens enough to make a very considerable difference in the number of Wasps in the summer. In 1881 I caught 250 Queens in two or three hours, and whether from this or some other cause there were certainly very few Wasps in the late summer and autumn. I identified the following species in the proportions per 100 given below, viz.:

Vespa rufa - - -	65
V. germanica - - -	15
V. britannica - - -	10
V. sylvestris - - -	7
V. vulgaris - - -	3
	100

I subsequently (June 12th) took two *V. arborea* Queens, thus completing the list of British *Vespidæ*, with the exception of *V. Crabro* (Hornet), which I have never known to occur in our district. *Cotoneaster Simmondsii* is also very attractive.

A. O. W.

Queen Wasps blown out to Sea.

While trawling about a mile off the shore between Rhyl and Prestatyn on September 13th, 1883, several Queen Wasps and only two or three workers came on board. It was almost calm, what little air there was being from the land. Probably a prevalence of southerly winds on our coast in the autumn would make a considerable difference in the number of Wasps' nests the following summer, as the Queens, being more unwieldy than the workers, appear to be more liable to be blown out to sea. Perhaps the destruction of Queens in this way may partially compensate for the survival of a large number during the comparatively mild winters of this coast, though they are still sadly too common in most summers. A. O. W.

Bombus pratorum using Deserted Birds' Nests.

On May 20th, 1883, I found a deserted Hedge-Sparrow's Nest containing eggs covered over with moss, and on disturbing it a female *B. pratorum* flew out. I cleared away the covering, leaving the eggs exposed, but two days later I found the nest again covered in, and the Bee flew out as before. On June 3rd I found a dead male Bee of the same species in the nest, which, however, seemed to have been forsaken by the female. The nest was in a low bush of Golden Yew. A. O. W.

Butterflies Tamed.

The young Thomases of Llandudno (whom I commended to you long ago as promising observers), have succeeded in taming certain species of Butterfly, but not the common white, which is too shy. They began by offering, *cautiously*, a "sugared" finger, on which the insect perched and fed, returning when shaken off, and finally following their friends up and down the garden, and alighting on them fearlessly. A fuller account appeared in a Manchester paper. Surely this is worth following up.

J. PRICE.

Instinct in Weevil.

While collecting insects on the hill near Glyn Farm, Colwyn Bay, on July 7th, 1887, I observed a bright green Weevil, which was new to me, on an oak leaf. When I stooped over it it at once contracted its legs and rolled off the leaf, falling on another below where it lay feigning death. I then placed my ring net (a green one) reversed, so as to form a flat surface, beneath the leaf and caused the beetle to roll on to it. The moment it touched the net it at once came to life and ran more swiftly than I could have thought possible for a Weevil, disappearing over the edge of the net into a tangled mass of vegetation below before I could secure it. Query—How did it know that I was dangerous, and that it would not do to feign death any longer when it touched the net? A. O. W.

Diplotis hyalina—MONTAGU.

In Vol. XI., p. 203, Table XIV. of the Linnean Society's Transactions (1815), that excellent Naturalist, COL. MONTAGU, describes and figures an animal under the above name. He states that it is a "Vermis of the Order *Intestina*," and goes on to say that had there been any well-authenticated account of any insect undergoing its transformation in the sea, its resemblance to an insect larvæ would have made him hesitate "as to the rank to which it should be consigned." In October, 1872, I found a small grub in decomposing sea-weed, at high water-mark on the shore of Colwyn Bay, which agreed perfectly with MONTAGU'S description and figure; only the great Devonshire Naturalist had mistaken its head for its tail. Being struck by its resemblance to an insect larva, I placed it in a bottle with some sea-weed, and in due time a Dipterous fly was produced from the supposed worm. GOSSE (Handbook of Marine Zoology, Pt. I., p. 99) places it among "Genera imperfectly characterized: apparently of Arenicolana" *(Annelida.)*

A. O. W.

Venus Mercenaria.—LINN. AMERICAN CLAM.

In 1883, I received from the late MR. T. J. MOORE, of Liverpool, a number of the above Mollusc alive which were placed by me in the following localities on :—

1. The flushing-pool at Bagillt Wharf;
2. At the point where the Channel leading to Bagillt Wharf enters the main Channel of the Dee, about one mile from the shore;
3. The Voryd, where the Chester and Holyhead Line crosses it at Rhyl;
4. The shore between Colwyn Bay Station and Eirias Dingle.

So far (February, 1893), there is no evidence of any having survived. The flushing-pool was cleaned out to the depth of two feet of mud about five years ago, but no sign of the Clam was found. A. O. W.

STINGING POWERS OF MEDUSÆ.

Of the common Jelly Fish (*Acalepha*) on this coast, only two, viz.: *Cyanea capillata* and *Chrysaora hyoscella* appear to have any power to sting a human being. The former, which is a large species of a dull red colour, with very long tentacles trailing behind it as it drifts with the tide, is by far the worst, and the effect of its "thread-cells" on some skins is serious. Rubbing with whisky or chloroform is said to be the best remedy. The *Chrysaora* is a pretty species, with black and yellow spots on the margin of the disk or "bell." I was stung by one of these while bathing at Colwyn Bay, on July 26th, 1868, on the fore-arm. The pain was very acute at first, but went off entirely in less than half-an-hour. Of the other two common *Acalepha*, I have tumbled *Rhizostoma pulmo* about while bathing, without feeling the smallest unpleasant sensation. This is the large species, with a deep bell, having somewhat the appearance of ground-glass of a more or less blue colour, and short thick tentacles. The fourth species, *Aurelia aurita*, which may be known by the four violet rings seen through the transparent colourless disk, is also, I believe, quite harmless. These facts are worth mentioning, as many people are deterred from bathing without cause, when these two last species are abundant.

A. O. W.

Sept. 26th, 1860, *Eucampia zodiacus* taken in the Dee, and drawn by A.O.W. in his diary. *Eucampia striata* (STOLTERFOTH) was first taken on July 25th, 1873, off Flint, and drawn by A.O.W.

A. O. W.

THE CLIMATE OF CHESTER.

BY A. O. WALKER, F.L S.

The District adopted by the Chester Society of Natural Science, comprising as it does the sea-coast of Flintshire and Denbighshire, and reaching to the S.W. corner of Cheshire, has, for its area, a very varied climate. In the former portion the close proximity of the most mountainous portion of N. Wales on the S.W., and of the sea on the N.E., has a very marked effect in modifying it; while in the latter the climate is much the same as that of the central area of England generally. The climate of the coast has been dealt with in another paper in this number, and as we are without accurate information as to temperature and rainfall for the extreme south-western portion, I shall confine my remarks to the City of Chester. I may, however, here refer to an excellent paper ("Twenty-five Years' Rainfall in Wirral"—Phillipson & Golder, 1889) by MR. REGINALD BUSHELL, in which much valuable information will be found on the Rainfall in Cheshire.

The Climate of Chester itself may be taken as intermediate between that of the coast and of the interior. The rainfall is a moderate one, but the average number of days on which rain falls is large in proportion to the amount of rain. Extreme cold is rare, the lowest temperature recorded of late years being that of January 16th, 1881, when the minimum in Stevenson Case at the Lead Works was 0°·8. Dense fogs are also rare, but there is generally more or less mist or haze during the winter months.

The annexed Tables of temperature and rainfall (except 1870-76) are from records kept at the Lead Works. The instruments were in a Stevenson Case, and the Thermometers carefully corrected.

TABLE I.

CHESTER RAINFALL, FROM 1870 TO 1889.

	INCHES.	NO. OF DAYS RAIN FELL.	WHERE RECORDED.
1870	21·51	164	Newton Nurseries
1871	29·81	168	,, ,,
1872	52·02	238	,, ,,
1873	24·49	157	,, ,,
1874	24·10	149	,, ,,
1875	30·35	185	,, ,,
1876	31·87	204	,, ,,
1877	37·10	234	The Lead Works
1878	29·58	198	,, ,,
1879	30·04	182	,, ,,
1880	32·64	164	,, ,,
1881	25·28	188	,, ,,
1882	33·91	210	,, ,,
1883	26·78	190	,, ,,
1884	24·85	154	,, ,,
1885	25·41	180	,, ,,
1886	33·67	193	,, ,,
1887	20·59	153	,, ,,
1888	24·32	190	,, ,,
1889	26·98	191	Newton Nurseries

TABLE II.

AVERAGE MONTHLY RAINFALLS AT CHESTER, 1880 TO 1889.

	INCHES.	ORDER OF WETNESS.
January	1·84	July
February	1·78	October
March	1·76	November
April	1·48	September
May	2·07	December
June	2·17	June
July	3·26	August
August	2·15	May
September	2·59	January
October	3·02	February
November	2·71	March
December	2·56	April

Average Yearly Rainfall, 1870 to 1889 = 29·26 inches.
Average Number of Days ·01 or more fell yearly = 184.

TABLE III.

CHESTER MONTHLY MEAN MAXIMUM TEMPERATURES.

	1879	1880	1881	1882	1883	1884	1885	1886	1887	1888
	°	°	°	°	°	°	°	°	°	°
January ..	35·8	40·7	34·7	46·6	45·7	*48·5	41·9	42·1	43·1	46·0
February .	42·3	*49·9	42·7	49·0	49·8	46·9	48·4	41·9	47·5	41·9
March .. .	48·1	52·9	48·3	*53·0	43·7	50·4	47·3	47·1	46·1	46·1
April	50·2	54·4	53·8	56·0	*56·8	53·4	54·0	55·7	53·2	53·0
May ..	56·2	58·5	*63·4	62·8	60·5	62·3	56·8	60·2	57·6	*63·4
June	64·0	65·5	64·6	63·6	66·6	67·1	66·5	66·3	*73·1	66·6
July	..	67·7	69·8	67·7	66·4	69·3	70·3	69·8	⁑73·4	65·6
August ..	..	71·9	64·3	66·7	67·3	*73·3	65·7	70·2	70·8	67·7
September ..	..	*67·1	62·2	62·5	63·7	66·9	63·2	65·0	62·1	64·5
October ..	57·0	51·3	52·6	56·4	55·7	55·8	51·6	*58·7	53·2	56·6
November ..	43·4	48·2	*54·3	48·3	48·7	48·2	48·4	50·1	47·0	52·5
December .	36·8	47·0	44·6	43·2	45·7	44·5	45·4	42·9	44·6	*49·0

The above Table shows the monthly averages or means of the *highest* daily temperatures for each month of the 10 years from 1879 to 1888. The items marked * are the *highest for that month*, and that marked ⁑ is the ***absolute warmest month*** in the 10 years.

TABLE IV.

CHESTER MONTHLY MEAN MINIMUM TEMPERATURES.

	1879	1880	1881	1882	1883	1884	1885	1886	1887	1888
	°	°	°	°	°	°	°	°	°	
January ..	25·9	31·9	⁑21·8	36·8	35·9	40·4	34·2	32·4	31·2	..
February ..	33·3	36·8	33·7	39·2	38·0	37·1	37·1	*31·3	33·1	31·9
March	34·4	35·5	36·4	39·0	*30·4	37·1	33·6	33·9	31·9	32·8
April	*35·8	39·7	38·1	36·7	37·9	38·4	38·6	39·8	*35·8	38·1
May	40·9	41·6	44·6	42·8	*40·5	43·8	40·6	43·4	42·6	43·1
June	49·3	49·3	48·9	48·9	48·8	48·5	48·4	49·2	50·3	*48·3
July	..	53·6	53·2	51·6	51·7	53·1	51·9	53·0	53·7	*51·5
August ..	..	53·9	50·7	53·5	*47·3	53·1	48·6	53·2	49·6	50·0
September ..	..	51·4	47·5	45·8	49·3	50·4	46·4	48·8	*45·4	47·4
October .	44·6	*37·6	39·3	43·3	43·4	43·9	40·8	46·5	38·8	..
November ..	*33·1	35·8	43·0	37·1	36·9	37·0	37·1	41·6	35·3	41·6
December ..	*26·8	36·9	34·1	34·4	37·4	35·4	34·3	31·5	32·0	34·4

The above Table shows the monthly averages or means of the *lowest* daily temperatures for each month of the 10 years from 1879 to 1888. The items marked * are the *lowest for that month*, and that marked ⁑ is the ***absolute coldest month*** in the 10 years.

FIRST APPEARANCE OF BIRDS, &c., IN CHESTER DISTRICT.

Date.	Chiff-chaff heard.	Willow-wren heard.	Swallows seen.	Corn-crake heard.	Cuckoo heard.	Coltsfoot in flower.	Coltsfoot in flower.	Pilewort in flower.
1871	—	Apl. 13, C. B. ...						
1872	Mar. 14, Holywell	—						
1873	Apl. 1, Broxton...	—						
1874	Mar. 30, C.B. ...	—						
1875	—	—						
1876	Mar. 31, C.B. ..	Apl. 22, Ch. ...						
1877	—	—	—	—	—	Feb. 8, B. ...		
1878	Apl. 3, C. B. ...	Apl. 14, C. B. ..	Apl. 13, C. B. ...	Apl. 30, C. B. ...	May 3, C. B. ...	Feb. 19, B. ...		
1879	Apl. 2, Mostyn ..	Apl. 23, Ch. ..	Apl. 10, Denbigh Apl. 9, Mold ...	Apl. 28, C. B. ...	May 4, C. B. ...	—		
1880	—	—	—	May 6, Ch. ..	Apl. 27, Nantwich	—	Feb. 22, Gresford	March 7, Eaton Road
1881	Mar. 19, Rhydymwyn	Apl. 11, C. B. ...	Apl. 30, Bagillt..	May 1, C. B. ...	May 1, C. B. ..	Mar. 7, B. ...	Mar. 10, Roodee	Mar. 10, Roodee
1882	—	Apl. 22, Ch. ..	May 6, Ch. ...	—	—	Jan. 28, B. ...	Feb. 20, Stone Bridge	January 26, City Walls
1883	Apl. 2, Ch. ..	Apl. 10, C. B. ...	Apl. 14, Pen-y-Cloddiau M'tain	Apl. 29, St. Asaph	Apl. 28, C. B. ...	Jan. 17, B. ...	Feb. 10, Roodee .	January 30, City Walls
1884	Mar. 25, C. B. ..	Apl. 10, C. B. ...	Apl. 29, C. B. ...	May 2, C. B. ...	May 1, C. B. ..	Feb. 14, B. ...	Jan. 10, Hooton .	Jan. 5, leaf only, City Walls
1885	Mar. 31, Ch. ..	Apl. 18, C. B. ...	Apl. 23, C. B. ..	—	Apl. 26, C. B. ...	Feb. 19, B. ..	Feb. 22, Eccleston	February 1, City Walls
1886	Apl. 2, C. B. & B.	Apl. 14, C. B. ..	Apl. 25, C. B. ...	—	Apl. 26, C. B. ...	Feb. 11, B. ...	Mar. 19, Queen's Park	February 12, City Walls
1887	Apl. 3, C B. ...	Apl. 16, C. B. ...	May 4, C. B. (2) .	May 4, C. B. ...	May 2, C. B. ..	Feb. 21, B. ...	Feb. 25, Eaton Road	Feb. 27, Eaton Road
1888	Apl. 12, C. B. ..	Apl. 25, C. B. ..	—	May 4, C. B. ...	Apl. 30, C. B. ...	Feb. 6, B. ...	March 5, Eaton Road	Mar. 7, Denbigh Mar. 14, Chester
1889	Apl. 15, C. B. ...	Apl. 28, C. B. ...	Apl. 29, C.B ...	May 2, C. B. ...	Apl. 27, C. B. ...	—	March 3, Eaton Road	March 1, Eaton Road
1890	Mar. 30, C. B. ...	Apl. 20, C. B. ...	—	—	Apl. 25. C. B. ...	—	—	—
1891	Apl. 5, C. B ...	Apl. 24, C. B. ...	Apl. 25, C. B. ..	May 8, C. B. ...	Apl. 26, C. B. ..	—	—	—
1892	Mar. 19, C. B. ...	Apl. 14, C. B. ...	—	—	Apl. 26, C. B. ...	—	—	—
1893	Mar. 16, C. B. ...	Apl. 6, C. B. ...	Apl. 23, C. B. ...	May 3, C. B. ...	Apl. 20, C. B. ...	—	Feb. 3, Flint ..	Feb. 26, Eaton Road

C. B.—Colwyn Bay. Ch.—Chester. B.—Bagillt.

A. O. W.

The Climate of the North Coast of Wales.

BY ALFRED O. WALKER, F.L.S.

Read October 28th, 1891.

IT is exactly twenty years and four days since this Society met to consider its organization and the objects and aim of its existence. On that occasion I had the honour of laying my views before it, and the plan I sketched out then, and which was accepted at that Meeting, has, with the modifications necessary to meet the development of the Society, been that upon which it has been carried on ever since. The Society's District has been extended from the six sections of the 1-inch Ordnance Map, of which Chester is nearly the centre, to the entire Counties of Flint and Denbigh (and to the rest of North Wales for exhibitive purposes), and as much of Cheshire as lies west of a line drawn southward from Warrington. The three Sections into which the Society was originally divided have also been largely added to as it became more comprehensive in its aims. On that occasion I also ventured to suggest that the principal object which the Chester Society of Natural Science should have before it should be the investigation of the natural history of its own District, and the correlation of its *Fauna* and *Flora* with its climate and soil. So far as the former of these two objects is concerned, much has been done. The Grosvenor Museum, under the energetic management of MR. NEWSTEAD, promises soon to be a model of what a Local Museum should be; and the Kingsley Memorial Prizes have been invaluable in increasing the number of local specimens in the Museum. It is, however, needless to say that much yet remains to be done. In the great world of insects there is a fairly representative collection of the *Macrolepidoptera*, but the "*Micros*" are so far scarcely touched. Again, in the *Coleoptera*, I question if we have one-tenth of the British species; and the *Hymenoptera*, with the exception of the *Aculeates*, of which MR. NEWSTEAD has formed a very respectable collection, are so far wretchedly represented. The same may be said of the *Diptera*, in spite of the excellent collection of these and other insects for which the MISSES TOMLIN so deservedly received the Kingsley Prize in 1889. And so I might go on throughout the Animal Kingdom. In no single department, except perhaps shells, can we be said to have anything like a complete collection of local forms. And this is the more regrettable because until our lists are tolerably complete it is impossible to carry out satisfactorily the second of the above-mentioned objects, viz.: the correlation of the *Fauna* and *Flora* with the Climate and Soil.

Yet imperfect as our lists and collections are, it may be taken as proved that there are certain forms which are common to the south and east of us, but either wanting or rare in our district. Let us take a few birds as an illustration, and confine our attention to the Welsh portion of our district, as exhibiting the peculiarities of our Climate in their most extreme form. Why have we no Nightingale in Wales, or indeed in Cheshire, except as a very rare visitor in the extreme south-west corner? As an observer of birds for more than thirty years, and having a tolerably perfect knowledge of the notes of all the species that occur at all commonly in my own neighbourhood, I may venture to say that I have never seen or heard along the Welsh Coast from Bagilt to Llandudno, including a considerable range inland, any of the following species:—

Erithacus luscinia—Nightingale.
Ruticilla phœnicurus—Redstart.
Muscicapa atricapilla—Pied Flycatcher.
Acrocephalus arundinaceus—Reed Warbler.
Sitta Cæsia—Nuthatch.

Yet these are all fairly common birds in the south and even midland counties. The Lesser Whitethroat *(Sylvia curruca)* is rare in the neighbourhood of Colwyn Bay; though its laughing note may commonly be heard in the London parks and squares. So again the Nuthatch, which I have heard in Eaton Park, and whose note is so loud and unmistakeable that it never fails to arrest my attention in the Southern Counties, appears to be entirely absent from the parts of Wales known to me; nor does it appear in Mr. Brockhole's list of the Birds of Wirral, published in Part I. of our Proceedings.

The Sedge Warbler again, so common in Cheshire, is comparatively scarce in Wales. Others of the *Sylviadæ*—the Chiff-Chaff, Willow Wren, Wood Wren, Blackcap, Garden Warbler, Grasshopper Warbler, and Whitethroat—are common enough, the three first-named, very common; so are all the four species of Swallow. It therefore appears improbable that scarcity of insects should be the cause of the absence of certain species of insectivorous birds when other species, equally dependent upon insect food, occur abundantly. It would seem rather as if it were the direct action of climate on the bird itself.

The influence of small differences of temperature and humidity upon living organisms has never, so far as I know, been sufficiently taken into account. Yet it must be vastly more important than we imagine if so slight a difference as exists (when expressed by degrees of temperature or relative humidity) between, say, Chester and Llandudno, should determine whether or not it is possible for any given species of bird to exist. It is true we are all of us conscious of a difference in our own sensations when we go from the one place to the other, but so far nobody has been able to account for that difference by means of meteorological instruments. We all know that one place "agrees with us" better than another, but nobody knows why. And if our physical condition is affected by the climate in which we live, and if, as is undoubtedly the case, our mental condition is largely dependent on our physical, is it not clear that in course of time, our character and that of our descendants to whom it is transmitted, will become profoundly modified by any change? I cannot conceive that the descendants of English Colonists, say in the hot dry climate of Queensland, will not be very different people from their progenitors in the course of a century or two. De Quatrefages many years ago asserted that the white inhabitants of the United States were becoming assimilated to the aboriginal Red Indians in their features, owing to the influence of their dry climate. And I do not think it is fanciful to suggest, that the peculiarities of the Irish people may be due as much to the influences of climate as of race. If so, then we can understand how the English settlers, in early days, came to be as the old Historian wrote, "*Hibernicis ipsis Hiberniores*"—more Irish than the Irish themselves. But in the north-east, where the climate is drier, the descendants of the English and Scotch settlers of Cromwell's time, seem to have retained their original energy and industry. It is not a very comfortable theory for Irish reformers, as they will hardly find the moisture-laden breezes of the Atlantic amenable to Acts of Parliament!

One more illustration of the effect of a difference in rain-fall on the habitat of a plant. In Flintshire, *Parnassia palustris* (Grass of Parnassus), grows in marshy ground alongside the railway, near Mostyn Station, about the level of high-water at spring tides. I think our botanists will bear me out when I say, that it would be utterly useless to look for it even in wet places on Halkyn Mountain. Yet fifty miles east of Halkyn, on the hill side above Buxton, more than 1000 feet above the sea, it grows abundantly on the steep slopes of the old heaps of mine waste—just such heaps, and from the same kind of mines (lead), from the same formation, viz., Carboniferous Limestone, as are found all over Halkyn Mountain. The explanation no doubt is to be found in the fact, that while the rainfall at Buxton on an average of three years is 47·25 inches, that on Halkyn Mountain is 30·55 inches.

Having, I trust, shown the importance of climate as a factor in geographical distribution, I will go on to show what the difference, so far as it can be indicated by the Thermometer and the Rain-gauge, is between the Coast climate of our district and that of the neighbourhood of London. For purposes of temperature, I have taken the Quarterly Returns from the Royal Observatory, Greenwich, for the nine years during which they have been published by Mr. Glaisher in the Registrar-General's

Quarterly Report, and compared it with DR. NICOL's Returns from Llandudno for the same period, and taken from the same source. The rain-fall is taken from MR. GLAISHER's own returns at Blackheath, and my own at Colwyn Bay for the ten years ending December 31st, 1890. Both these stations are nearly the same height above the sea—Blackheath being 168 feet, and Nant-y-Glyn 180 feet. In place of "mean temperatures," I have used the "mean maximum" and "mean minimum" temperatures, or the mean of all the daily highest and lowest temperatures respectively. The use of the "mean temperature," which is obtained by adding together the mean maximum and mean minimum, and dividing by two, is very misleading. For instance, a locality where the mean maximum was 80°, and the mean minimum 20°, would give a mean temperature of 50°. So also would another locality where the mean maximum was 60°, and the mean minimum 50°; yet the climates of the two places would be very different in their effects upon animal and vegetable life.

The result of a comparison between the above-named localities may be thus briefly summarized:—It is hotter in summer, and colder in winter, near London, than on our Coast, while the average rain-fall of the former is 23·36 inches, against 30·77 inches at the latter.

The accompanying diagrams (see Tables I. and II.) will show the differences between the mean minima and maxima at Greenwich and Llandudno respectively, for the four quarters of the year. A much greater difference however is shown if we take the extreme temperatures on both sides reached during the nine years. The highest shade temperature at Greenwich was 94°·2 in August, 1884, and the lowest 12° in January, 1891. The highest at Llandudno was 84° in August, 1887, and the lowest 20° in December, 1890, and January, 1891. There was thus a difference of 10°·2 in the extreme maxima and 8° in the extreme minima of the two localities. The extreme range of temperature in nine years is therefore 82° at Greenwich and 64° at Llandudno. In Australia a range of 56° *in a single day* has been recorded (Heat as a Mode of Motion, page 407.) There the air is extremely dry.

The usual explanation given for the higher winter temperature of the North Wales coast is our old friend the so-called "Gulf Stream," which however is not the true Gulf Stream, but a warm current from the Equatorial region of the Atlantic Ocean, which strikes our shore and saves us from the rigours of a Labradorian winter. And no doubt this is quite true as regards our islands as a whole, but it is not easy to see why it should be of so much more benefit to us than to the Estuary of the Thames, or even (as is the case) to the south-east coast of England. In the latter case, the distance, say, from Land's End to Brighton is about the same as to Llandudno, while Brighton has the advantage of being about 170 miles further south; yet the winters are milder at Llandudno than at Brighton. Further, the sea on the north coast of Wales is so shallow that it cools down rapidly nnder the influence of severe weather. On January 12th of this year I found the temperature of the sea bottom some five fathoms below the surface to be 36°·5, when the temperature of the air was 49°. On January 11th, 1890, the temperature at the same depth, taken in the same manner with the same thermometer, was 46°, showing how greatly the sea temperature at shallow depths varies according to the atmospheric conditions. We had had some cold weather from January 5th to 11th, 1891, while the early part of January, 1890, was remarkably mild. On the whole I am inclined to think that the comparatively large amount of moisture in the atmosphere acting as a check both to the radiation of the sun's heat *to* the earth, and of the heat absorbed during the day *from* the earth at night, has at least as much to do with the equable climate of this coast as the "Gulf Stream." TYNDALL has shown what an enormous power of checking radiation is possessed by Aqueous Vapour (Heat as a Mode of Motion, page 403.) The consequence is that while the Isothermal lines in this country run north and south in winter, they run about east and west in summer. In other words, the mean temperature of Colwyn Bay or Llandudno is about the same as the Isle of Wight in January, and as Newcastle-on-Tyne in July.

The rainfall on the North Wales coast as represented by Colwyn Bay, may be considered as a moderate one. Compared with the London neighbourhood (Blackheath) an average of ten years (see Table III.) gives 30·77 inches for the former, against 23·36 inches for the latter. Taking the months in their order of wetness, (see Table IV.) we find that in both places October and November are wet months. But while at Blackheath July heads the list with 2·58 inches, at Colwyn Bay it comes sixth with only 2·49 inches; and June, which is fifth at Blackheath with 1·96 inches, is last (*i.e.*, driest) but one at Colwyn Bay with 1·89 inches. These are the only two months in which the rainfall is actually less at Colwyn Bay than London. August, which is the wettest month at Colwyn after November, exceeds Blackheath by 1·40 inches, this being the largest difference in any month.

Comparing Colwyn Bay with Chester, I find that on an average of eleven years (1878 and 1888 inclusive) the former place shows a rainfall of 31·11 inches on 176 days in the year, while Chester averages 27·92 inches on 182 days. But if we compare Colwyn Bay with the mountainous region to the south-west, we see a remarkable difference. Taking the rainfall of 1890 as an example, we have—

Colwyn Bay	31·10 inches
Llyn Dulyn, 1622 ft. above sea ..	124·40 ,,
Pen-y-gwryd, 880 ft ,, ..	138·80 ,,

Yet Llyn Dulyn is only fourteen miles in a straight line from Colwyn Bay, and Pen-y-gwryd about six miles further to the south-west. The explanation of this phenomenon has long been known. It is that the warm south-west winds, laden with moisture from the Atlantic, strike the mountains of North Wales, and are forced by these to rise into a colder region of the atmosphere. Now "the capacity of air for containing moisture doubles for a rise of temperature from 0° to 16°, from 16° to 33°, from 33° to 52°, from 52° to 73°, and from 73° to 96°." (Hygrometrical Tables by JAS. GLAISHER, F.R.S.) It follows from this, that air from the Atlantic reaching Snowdon at a temperature of 52°, and being cooled down to 33°, would have to part with one-half its moisture in the form of rain, and passing on to the north coast, will arrive there *comparatively* dry.

There is a feature in the climate of the coast of Flintshire and Denbighshire, west of the mouth of the Dee, that deserves notice, as it adds greatly to its value as a winter residence. Those who are much in the habit of travelling westward along the Holyhead line in winter, cannot fail to have observed that, in foggy weather, the fog suddenly diminishes in thickness, if it does not altogether disappear, at a point between Mostyn and Prestatyn somewhere about the Point of Ayr, where the Estuary of the Dee ends. From this point to Llandudno at all events, and probably all along the north Coast of Anglesey, fogs of any density are of rare occurrence. I have not attempted to collate the returns in GLAISHER's Reports on this subject, because such returns, depending as they do merely on the impression in the mind of the reporter, are of little value. But the fact is undeniable, and is the more remarkable, as the Irish Channel between Holyhead and Kingstown has a bad reputation for fogs. As an illustration, I may quote an entry in my diary on February 20th, 1891, when I travelled to London. "Misty or foggy everywhere. West of Point of Ayr one could see the hills four or five miles off—east of it about 400 or 500 yards." The cause of this immunity from thick fog has yet to be ascertained. Possibly it may be due (paradoxical as it may seem) to the comparative moisture of the atmosphere of the coast, as compared with that further inland. For it is certain that evaporation from the earth is greater at equal temperatures in proportion as the air is drier, and that evaporation causes cooling of the surface. It seems, therefore, probable that this cooling of the earth may condense the aqueous vapour in the lower strata of the atmosphere into fog in the drier region; while in the moister, the comparatively slow evaporation leaves it uncondensed and the air consequently clear. This, however, is only true within certain somewhat narrow limits of temperature and humidity.

Another obscure question is—What constitutes a bracing climate? According to my view, a *dry* climate is the really bracing one. But this implies, as we have seen, a climate of at least considerable extremes of heat and cold, or the exact opposite of that of our coast, where, as I ascertained by concurrent hygrometric observations for some years, it is decidedly moister than even at Chester. Yet most inhabitants of this city think they are "braced" by a change to the Coast! The fact probably is that the change, from some unknown cause, does improve their bodily health, and the sensation of this improvement gives the impression of being "braced."

Finally, let us consider what the economical effects of the difference between the south-east of England and our district are. Agriculturally, this difference means that the former is a wheat country and the latter a dairy and stock-breeding country. And this again means that in the former the competition of the cheap land of America, and the cheap labour of India, has ruined farmers, impoverished landlords and clergymen, and thrown thousands of acres of land (temporarily at least) out of cultivation, with all the concomitant distress to other classes implied by these conditions. In the latter, the distress has been comparatively trifling, and that, I think I may venture to say, in direct proportion to the amount of atmospheric humidity. Here, too, the insect pests that cause serious injury to farmers and gardeners, and to the south-east are comparatively innocuous. Again, the same comparative immunity (compared with our southern neighbours) extends to gardeners. In Cheshire, certainly, the Gooseberry Sawfly is often a pest, but I have never seen it at Colwyn Bay. In the south the havoc wrought among fruit trees by the larva of the November moth was very serious in 1890—has any gardener here ever suffered seriously from it? In short, I cannot name a single insect that does serious damage to farm or garden crop on our North Wales Coast! But, on the other hand, we miss those additional degrees of solar heat to ripen both the wood and the fruit of our Pears and Apples, and it is vain to expect either the quantity or quality of fruit that the Kentish gardener grows. But much may be done by the choice of sunny sites and by modes of training trees so as to give wood and fruit the greatest possible exposure to the sun; and the greater freedom from severe spring frosts is in our favour. On the whole, we of the north-west have reason to be thankful for our moist atmosphere.

TABLE I.

Mean Minimum Temp. Average for nine years at Greenwich .... and Llandudno ———

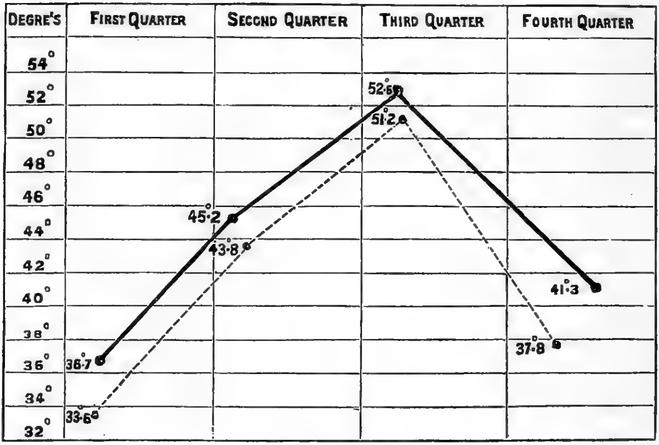


TABLE II.

Mean Maximum Temp. Average for nine years at Greenwich .... and Llandudno ———

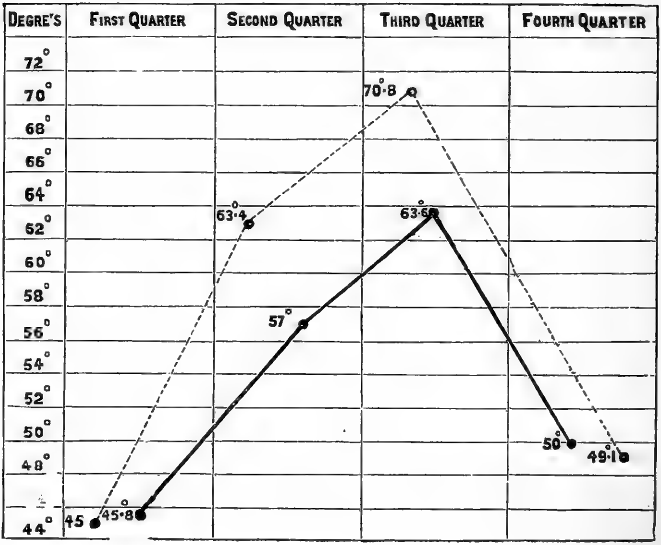


TABLE III.

Rainfall at Colwyn Bay, 180 feet above Sea.

	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1881.. ..	0·65	2·45	2·63	0·90	2·65	2·81	2·13	6·82	0·98	2·52	4·27	2·99
1882.. ..	2·93	1·71	2·34	3·01	1·54	3·39	3·20	3·47	2·45	2·54	4·89	3·49
1883.. ..	3·49	3·67	2·26	0·68	1·86	2·15	1·13	2·19	4·34	3·95	3·74	1·89
1884.. ..	3·67	4·24	2·63	1·32	1·37	1·15	4·43	1·35	1·67	1·55	3·03	2·35
1885.. ..	1·82	3·50	1·26	1·52	1·41	1·10	1·15	1·58	2·80	5·55	2·27	1·24
1886.. ..	3·16	1·50	2·44	2·38	4·91	1·69	3·14	1·36	3·55	5·71	3·88	5·13
1887.. ..	3·59	0·93	1·94	1·73	1·57	1·06	1·73	3·37	2·88	3·05	2·21	2·95
1888.. ..	1·06	0·56	2·03	1·73	1·12	2·46	4·37	3·63	1·39	2·30	4·28	2·02
1889.. ..	1·24	1·61	1·90	4·29	2·91	0·69	1·70	4·99	2·94	3·84	2·	3·55
1890.. ..	4·88	1·29	1·30	1·03	2·28	2·38	1·89	4·83	1·54	1·71	6·61	1·36
	26·49	21·46	20·73	18·59	21·62	18·88	24·87	33·59	24·54	32·72	37·18	26·97
Average ..	2·65	2·15	2·07	1·86	2·16	1·89	2·49	3·36	2·45	3·27	3·72	2·70
Highest ..	4·88	4·24	2·63	4·29	4·91	3·39	4·43	6·82	4·34	5·71	6·61	5·13
Lowest ..	·65	·56	1·26	·68	1·12	·69	1·13	1·35	·98	1·55	2·	1·24
Range ..	4·23	3·68	1·37	3·61	3·79	2·70	3·30	5·47	3·36	4·16	4·61	3·89

TABLE III.—*Continued.*

Rainfall at Blackheath, 160 feet above Sea.

	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1881.. ..	2·16	2·51	1·59	·40	1·56	2·03	2·16	4·64	2·40	2·97	2·47	2·74
1882.. ..	1·16	1·21	1·31	2·67	1·53	2·31	2·66	1·06	2·81	6·53	2·50	2·03
1883.. ..	1·75	2·64	0·73	1·73	1·70	1·47	1·91	0·54	4·61	1·54	3·12	0·76
1884.. ..	1·73	1·25	1·24	1·12	0·93	2·11	2·18	0·25	2·16	1·08	1·18	1·99
1885.. ..	1·15	2·18	1·46	2·02	2·22	1·51	0·46	1·38	3·67	3·11	2·70	1·01
1886.. ..	3·45	0·56	0·99	1·29	4·22	0·47	2·40	1·01	1·05	1·52	3·05	3·81
1887.. ..	1·14	0·68	1·09	1·50	1·84	1·25	0·88	3·	2·56	1.07	3·98	1·49
1888.. ..	0·95	1·06	2·53	1·55	0·63	3·50	6·59	3·59	0·78	1·26	3·74	0·90
1889 . ..	0·82	2·32	1·29	1·86	3·21	2·13	2 04	1·57	1·49	3·93	0·80	1·35
1890.. ..	1·84	1·10	1·80	1·67	1·30	2·79	4·52	2·59	0·70	1·11	1·48	0·69
	16·15	15·51	14·03	15·81	19·14	19·57	25·80	19·63	22·23	24·12	25·02	16·77
Average ..	1·61	1·55	1·40	1·58	1·91	1·96	2·58	1·96	2·22	2·41	2·50	1·68
Highest ..	3.45	2·64	2·53	2·67	4·22	3·50	6·59	4·64	4·61	6·53	3·98	3·81
Lowest ..	0·82	0·56	0·73	·40	0·63	·47	·46	0·25	0·70	1·07	·80	·69
Range ..	2·63	2·08	1·80	2 27	3·59	3·03	6·13	4·39	3·91	5·46	3·18	3·12

TABLE IV.

Order of Wetness.

BLACKHEATH.	In.	COLWYN BAY.	In.
July	2·58	November	3·72
November	2·50	August	3·36
October	2·41	October	3·27
September	2·22	December	2·70
June	1·96	January	2·65
August	1·96	July	2·49
May	1·91	September	2·45
December	1·68	May	2·16
January	1·61	February	2·15
April	1·58	March	2·07
February	1·55	June	1·89
March	1·40	April	1·86
	23·36		30·77

The Heron and Heronries of Cheshire and North Wales.

BY R. NEWSTEAD, F.E.S.
(CURATOR OF THE GROSVENOR MUSEUM, CHESTER.)

Read January 31st, 1890, and revised to date of publication.

SO much has been written from time to time on Herons and Heronries, by Archæologists and Naturalists, that I have only been able to make a few original observations.

So far as the Heron is concerned, only such notes as are likely to prove of interest have been appended, and these are either from my own observations or gained from trustworthy sources, duly acknowledged. The historical facts are arranged as near as possible in chronological order; many of them being very quaint and interesting, and as I know of no publication containing such *in extenso*, I have ventured to give them here.

LOCALITY.

I first commenced to gather information respecting the Cheshire Heronries in 1886, and shortly after extended the district by taking in North Wales; but in both districts I have somewhat exceeded the Society's boundaries.

THE HERONRIES.

These are the breeding places of the Heron; and any naturalist who has not visited the homes of this bird, has—if he does not mind the somewhat strong smell—a treat in store.

In the Zoologist, 1872-3, pp. 3261, 3369, MR. J. E. HARTING published a list for all the then-known Heronries in the United Kingdom, numbering in all 300; 171 for England and Wales, 72 for Scotland, and 57 for Ireland. Six are given for Cheshire, one for Flintshire, and one at Penarth.

SAUNDERS says (Brit. Birds, p. 355): "In England the number of its colonies has suffered no diminution, though many of them are seriously reduced in size as compared with former times."

I am sorry, however, to say that of the Cheshire Heronries only two are now existing, but of the nineteen reputed Heronries in North Wales, twelve are still in existence, several of which have not hitherto been recorded. To obtain the records I have, except in very few instances, written the various owners, or those employed on the estates. From those districts where the Heronries have long since ceased to exist, I have had but few replies, and frequently none at all. In such cases I have had to fall back on "Ormerod's Cheshire," which, fortunately, furnished the needful information. I would, however, have preferred the information direct from the spot, but no one seemed able or willing to help.

LIFE HISTORY.

The Heron begins to nest very early in the year, about the same time as the rooks, and incubation lasts about twenty-eight days. In his "British Birds" [l.c.], MR. SAUNDERS says "that sometimes a second clutch of eggs are laid a fortnight after in the same nest." SEEBOHM, in contradiction to this, says: "only one brood is reared in a year." (British Birds' Eggs, Vol. ii., p. 468.) Hitherto, however, no one seems to have observed that the Heron sometimes lays one egg and then commences to sit, leaving an interval of some time between the laying of each egg. As a proof that such is undoubtedly the case, I may quote the following from my own observations made in the Heronry at Eaton, during my visits there for the purpose of obtaining the life-history group now in the Museum, by kind permission of HIS GRACE THE DUKE OF WESTMINSTER, K.G. The nest of four young birds in the group referred to are most decidedly in various stages of development; the smallest, I should say, was quite a fortnight younger than its full-fledged companions, and the latter differed in the condition of their plumage and size. A second nest examined contained one egg and a young bird, which, from its size, must have been nearly a week old; and a third nest contained five young in various stages of development. MR. HARTING mentions in "The Essex Naturalist" (Vol. ii., p. 171), "that in blowing a clutch of eggs taken by him from a nest in the Heronry at Birch, two proved to have been much longer incubated than the other three;" but the thought does not seem to have occurred to MR. HARTING that such was the frequent habits of these birds. Thus, there seems to be no definite system either in the laying of the eggs or the commencement of incubation.

The "Purple Heron" (*Nycticorax Griseus, L.*) is said to lay one egg and then commence to sit, and that there is an interval of two days between the laying of each egg. [Saunders' Brit. Birds, p. 368.] In this case, there is a definite period between the laying of each egg, which, so far as is at present known, is not the case with the common Heron. Undoubtedly, nature has so ordered this to diminish the amount of food required day by day, which would be very considerable if all the young birds in a nest attained the same size at once. The nest is very large, often measuring four feet in diameter; it is composed of large sticks and lined with various materials. Those that I examined in the Eaton Heronry had little or no lining in them; one nest was lined with a few dead stems of the Purple Loosestrife (*Lythram Salicaria, L.*), which grows abundantly in and near the wood; the others had nothing but thin sticks broken very short.

Food.

The Heron is almost omnivorous. Some very curious details of the food of the Heron have been placed on record from time to time which would form a small volume in themselves. The angler, of course, has not forgotten to mention trout in the bill of fare, forgetting the good work the Heron does in clearing off young pike and eels, both of which are very destructive to other fresh-water fish. A friend of mine, Mr. Stretch, of Ledsham, three years ago procured from the Hooton Heronry a young Heron, which, when first taken from the nest, refused to eat anything offered it. To keep it alive my friend was obliged to cram food into its gullet as the only means of keeping it. The bird, however, soon helped itself to food, and eventually became remarkably docile. Its food consisted almost entirely of animals; it never tasted fish from the time it was taken from the nest until its death two years after. Mr. Stretch tells me that this bird would swallow as many as five nearly full-grown rats at a single meal, and that it had a very peculiar habit of dipping its food in water before swallowing it; for this purpose, a large earthen jar of water was always kept in the garden.

If the bird had been kept for a few days without food it would generally swallow the first object without dipping it in the water, but as a rule it would carry its food—no matter how far from its reservoir—and give it a good shake in the water before swallowing it. To show how omnivorous this bird was, two Russian kittens were introduced into the garden. No sooner were these valuable pets introduced than Mrs. H. succeeded in making a meal of one by swallowing it entire, and had she not been discovered in the act she would have made a second course of the other kitten. This bird afterwards became so remarkably tame that it often proved a hindrance to the workmen. If the latter were digging in the garden the bird would be ever with them, on the look out for any worms or insects that they might turn up. To use Mr. Stretch's own words, "It was tamer than his dogs, and, like them, would follow him almost everywhere." To the dogs it was a perfect terror. If any food was given them in her presence she would be sure to take it from them; even if they carried it into their kennels, her long neck and powerful beak proving more than a match for them. But nevertheless the dogs were the cause of her death: accompanied by these and the heron, MR. STRETCH was going his usual rounds with his lantern to see all safe, when suddenly the dogs bolted a rat, and in their scurry knocked down the poor heron and immediately commenced to tear it to pieces, thinking, no doubt, that it was the original object of their chase. I need not say that my friend much regretted the loss of his pet bird.

Although the Heron has been known to swallow larger objects than the Russian kitten already referred to, I can only find a single record of a Heron having been found that had choked itself. In this instance the bird was found choked by a full-grown water-rat, which had fixed itself so firmly in the bird's throat that it could not be withdrawn. I am inclined to think that if the rat was swallowed alive, as was most probably the case, it might have bitten the Heron, and so disabled it that it died. Certainly a full-grown rat seems a large object for the bird to swallow, but it is small in comparison with the previous records, or the following: "Stowed away in the gullet of one individual"—as recorded in "The Field"—"were eleven perch, averaging three inches in length;" "and another had regaled itself with a nice little pike, eighteen inches in length, setting teeth and spines at defiance."

ANATOMY.

The gullet of the Heron has an enormous capacity, and it seems that no matter how full this is filled everything is so arranged that the bird can bend its neck so as to be able to rest its head on its shoulders, and then *apparently* sleep till all is digested. I mention this as I wish to call attention to the anatomical structure of the neck, which is really very remarkable. If the skin of the neck of a Heron be carefully removed, and the neck afterwards be stretched to its fullest extent, it will be seen that the course of the windpipe (*Trachea*), and gullet (*Esophagus*), are perfectly straight; while the neck (*Vertebræ*) assumes the form shown in the illustration, and no amount of stretching will make it perfectly straight without destroying it. [Plate 1, fig. 1.] The anterior end of the gullet is attached to the ventral surface of the neck until it reaches the fifth and sixth vertebræ, over which it suddenly crosses, on the right side, to the dorsal surface of the neck, along which it extends to the twelfth and thirteenth vertebræ, over which it again crosses on the same side to the ventral surface, and finally enters the body. The trachea, which follows the same course, is attached to the ventral surface of the esophagus. Fig. 2 shows the neck of the bird in its natural resting position, and it will be seen that it is bent downwards and backwards, causing the central portion of the neck to become considerably arched, and were it not for the peculiar lateral and dorsal arrangement of the trachea and esophagus, these latter would receive an unpleasant pressure, especially if the gullet contained food. To me, without this wonderful arrangement it would be impossible for the bird to bend its neck at all after swallowing a large eel or several large objects; but owing to this curious arrangement it will be seen that the Heron may bend its neck, after taking food, as much as it chooses, and yet at the same time the course of the gullet remains practically straight, from the anterior extremity to its entrance to the body. The trachea, from its more inflexible nature, becomes very much bent, but follows nearly the same course as the vertebræ. It is almost impossible to describe this wonderful piece of mechanism in words, but a careful study of the figures—or better still, of actual specimens—will make the matter quite clear.

My best thanks are due to Mr. Farrimond for kindly reducing the illustrations by photography, which were originally drawn natural size.

Castings.

After the food is digested, the indigestible parts are cast up in the form of "pellets." On examining some pellets which I found in the Eaton Heronry, not the slightest trace of a bone of any kind could be found, which is very strange, as they consisted almost entirely of rat's fur. *Query*—Do the Herons digest the bones as well as the flesh? If they do not, then how is it possible for them to separate the fur from the bones? All our birds of prey cast up the indigested portions of their food, but bones, fur, and feathers, &c., are cast up together; they are not separated!

Preservation.

In the nineteenth year of the reign of Henry VII., 1504, it was enacted, that "no person without his own ground shall slay, or take by craft or engine, any herons, except with hawking or long-bow, on pain of forfeiture for every heron, 6s. 8d.; and no person without his own ground shall take any young herons out of the nest, without license of the owner of the ground, on pain of forfeiture for every heron, 10s." (19th Hen VII., c. 2, s. 1.) Still further, it was enacted that "from first of March to the last of June yearly, no person without license of the owner of the ground shall kill a heron, on pain of forfeiture for every heron, 10s." (19th Hen. VII., c. 2, s. 1.) And in the twenty-fifth year of the reign of Henry VIII, 1534, "from first of March to the last of June yearly, no person shall withdraw, take, destroy, or convey any eggs or wild fowl from or in any nest where they are laid, on pain of imprisonment for one year, to forfeit for every egg of any Crane or Bustard, 20d.; and for every egg of Bittern, Heron, or Shovelard, 8d.; and for every egg of Mallard, Teal, or other wild-fowl, 1d." (25th Hen. VIII., c. 2., s. 5.) And in the twenty-ninth year of his reign (1538), this King likewise gave the first Charter to the Artillery Company, by which they are permitted to wear dresses of any colour except purple and scarlet, to shoot not only at marks, but birds, if not Pheasants or *Herons*, and within two miles of the Royal Palaces (Archæologia, Vol. vii., p. 67.)

The Act passed in the eighth year of the reign of Elizabeth, 1566, for the "preservation of grayne, and destruction of birds and vermin, was not in any wyse to extend . . . . to the dysturbance, lett, or the destructyon of the buyldinge or bredinge of anye kinde of Hawks, *Herons*, Egrypts, &c." (East Anglian, Vol. iii., pp. 275-9.)

In the first year of the reign of James I., 1602, it was penal "to shoot with any gun within 600 paces of any herony." (1st James I., c. 27, s. 7.) This latter remained in force until the year 1831; and the other sections remained in force until they were repealed by the Game Act in the first and second year of the reign of William IV., 1830-31 (1st & 2nd Will. IV., c. 32.)

The object for which the Heron was thus protected is two-fold. First, for the use of the sportsman or falconer; and secondly, to supply the demand of the market for its use as food for the tables of the wealthy.

Space will not allow me to enter into the former interesting subject (Falconry), but of the latter I append a few notes which may be of interest.

As Food.

During the fourteenth to the seventeenth centuries the Heron formed part of the royal bill-of-fare, and we find it also mentioned as a dish for the various feasts held during these periods, thus:—In the twenty-first year of the reign of Richard II. purvëyance is made for the King being with the Duke of Lancaster at the Bishop of Durham's Palace, at London, on the 22nd of September, 1379, for—*V. Herons* and Bitours (Bitterns), XII. Cranes. And the second course consisted of: A Pottage, Pigges roftid, Cranes roftid, Fesaunts roftid, Herons roftid, &c. (Archæologia, Vol., ii. p. 173.) And at the Stallyng (installation) of John Stafford, Archbishop of Canterbury (21st Hen. VI.), in the year 1443, "there was at the first course Heronfewe, and at the second Crane roftid." (Archæologia, l.c.) At the great enthronisation feast of George Nevil, Archbishop of York (1466), "there were 204 Cranes, 204 Bitters, and 400 Heronshaws." (Archæologia, l.c.) In the order of a Feast Royal made by Cardinal Wolsey, "there was to be at the first course Heronfewe or Bitter, and at the second Crane roftid, &c."

From these records one may rightly suppose that the Heron was considered "the dainty dish to set before the King;" but by the middle of the eighteenth century the Heron was very much grown into disuse. And we find in the Duke of Northumberland's MS. that "Herons and Bitterns are not so totally lost to us as the Crane, but are as much grown into disuse at our tables." (Archæologia, l.c.), dated February, 1769.

The proper terms used in carving these wild-fowl were:—for the Crane, "displaye that Crane"; for the Heron, "dismembre that Heron"; and for the Bittern, "unjoynt that Bitture." These curious facts were taken from a book printed A.D. 1508 (Archæologia, Vol. ii., p. 172.); and the usual price of the Heron seems to have been XIId. Occasionally, a specimen or two may be seen hanging at one or other of our fish-shops in the town, I fear only for attraction, as they rarely find their way to our tables, owing—as people suppose—to their being unfit for human food. Opinions, however, differ in this respect. One will tell you that they are excellent eating, while another will tell you that they are "beastly." Speaking from experience, I cannot say much for their high qualities, although I found their flesh much better eating than many of the wild-duck which are often served up at our tables, especially if the latter have been feeding on our estuaries up to the time of their being killed for the market. I sometimes fancy that the original method of preparing the Heron and other wild-fowl for our tables have been entirely lost to our modern cooks. I don't suppose that I have rediscovered the method, but I find the following quaint entry in the *Archæologia*, quoted from Muffet's Treatise on Food, London, 1655:—"To render Storke, Bitter (Bittern) and Herone, fit to be eaten, chose the youngest and fatest, for they may be eaten so with *much* spice, salt, or onions, and being thoroughly kept in a draught of old wine." "If they be dressed without their skins they relish far better, according to the French and best fashion, who also stuff them full of sweet herbs and draw them with fine and small lard."

During the seventeenth century the Heron seems to have been in season (regardless of the law), every month except April and May.

There is, in the *Archæologia*, a copy of a very curious old manuscript, dated 1605, entitled "a Breviate touching the order and government of a nobleman's house;" which is really a list of wild-fowl, &c., for each month of the year, in which the Heron is given, except for the months of April and May (*Archæologia*, Vol. xiii., pp. 340-372.)

In looking through the various works referred to, I have been interested in the various ways in which the word Heron is spelt; thus—Heronne (2), Heronshaw (1), Heronfewe (11), Hernne (3), Herone (3), Heron (6), the latter being the way we spell it at the present day.

In a rare old book entitled "Pharmacopæia Londinensis," printed 1685, are some of the most remarkable passages relating to the uses of birds and animals, for medicinal purposes, that I ever read. There is one relating to the Heron, as follows:

"Ardea Anapha . . . . . 1. The flesh is better than that of the Crane, but best when young; and eaten by the nobility in France. 2. The bill in powder, being drunk, causeth sleep. 3. The grease is anodyne, and eases pains of the gout, helps deafness, and clears the sight. It makes a good bait to catch fish with." In Cheshire, at the present day, many people still use the fat from the Heron's body as an attractive bait for fish.

In the different counties the Heron is known to the peasantry by the following names:—Heronshaw (Cambs.), Harnces or Franks (Norfolk), Moll-herns or Frank-herons (Essex), Varn or more often Yarn (Cheshire.) I am inclined to think that all these local names, and some others not mentioned, are derived from the peculiar call-note of the bird. Crëyr or Crehyr is, I believe, its correct Welsh name. There is, however, a local name which is not without interest. "Crydd Glas" (Grey Shoemaker), was given to me by MISS WYNNE JONES (Chester), and the late MR. WM PARRY (Colwyn Bay.) The reason MR. PARRY gave was: "That the bird lost its money for a pair of boots in the brook, and has been looking for it ever since." I have written this verbatim as it was given me. MISS WYNNE JONES, of Chester, tells me that the bird derives its local Welsh name from the loud smacking noise that these birds make with their beaks at feeding time, which is produced by bringing together the two mandibles with terrific force—similar to that of the owl—and which closely resembles the "Cobbler at work with his lapstone."

Before leaving our friend the Heron, I should just like to mention one other fact, which MR. SIDDALL has kindly furnished me with, with regard to a very singular way some of the Welsh people have of capturing the Heron alive. It was during hay harvest, a few years ago, while MR. SIDDALL and others were staying at Cwm Bychan, near Harlech, Merioneth, that the following curious circumstance took place:—Two boys were seen crawling upon their hands and knees, apparently stalking a Heron, and noticing that they had nothing wherewith to kill the bird, MR. SIDDALL (Chester) enquired of an elderly Welshman as to how the boys would take it. The answer he gave was: "You see, sir, the bird was have a very small heart, and if the boys can get close up to it and frighten it, the bird was break its heart!" A few days afterwards a Heron was brought to MR. SIDDALL said to have been thus taken. The bird was alive, and seemed perfectly healthy, but on freedom being offered it, the bird was unable to fly away; it was carefully examined, but neither bruise nor wound could be seen. It was, as the Welshman declared, "heart-broken." From the wary and crafty habits of the Heron one can scarcely credit this singular story, but I give it for what it is worth.

"Ars longa, vita brevis."

HERONRIES.

CHESHIRE.

Eaton, near Chester

(The Seat of His Grace the Duke of Westminster, K.G.)

This is the largest of our Heronries, and is situate in the "Duck-wood" near the Hall. It consists of between forty and fifty nests, nearly all of which are built in the tops of very tall willow trees. Some nests are quite isolated, others are in groups of various numbers. In eight trees I counted twenty-one nests, but owing to the numerous and intricate ditches which traverse the whole of the wood like the paths of a labyrinth, one has to be satisfied with exploring one-half of its dimensions: especially in wet seasons. On one occasion when visiting this Heronry the ditches had overflowed their banks to such an extent that the only means of getting from place to place, was by laying a ladder over the large pools of water. But for all this, there is a charm about this wood I cannot well explain. Here, until a few years ago, might be heard the boom of the Bittern; and the Teal, Wild Duck, Great-spotted Woodpecker, and other interesting birds, still find a secluded spot wherein to rear their young; and in season the luxuriant growth of the Iris and Purple Loosestrife, also give enchantment to the spot. The life-history of the Heron, preserved in our Museum, was taken from this Heronry, by kind permission of His Grace the Duke of Westminster, and now forms one of the most attractive objects in the collection.

When taking the nest and young, one of the birds flew away into an adjoining tree, and when dislodged it came down in an almost perpendicular direction. Intervening between it and the ground there was a small branch, upon which the bird tried to alight; failing this, it hooked its long beak over the branch and tried to gain a foot-hold. but was unable to do so. I thought it very remarkable that the bird should be able to hang on to an object by simply placing its closed beak on the branch, but such was the case, and as I kept the birds for many days after as living models, I was much interested to see them on several occasions use their beaks for supporting their bodies, in situations where it was difficult to get a foot-hold.

Mr. Alderman Charles Brown tells me that there used to be a Heronry at "Heron Bridge," and that on either side of the River Dee at that point there were two very large willow trees whose branches *met*, and formed (as it were) a natural bridge; and says that it is from this fact that the place derives its name. I am also informed that the Herons built at Eaton after leaving "Heron Bridge." I should be glad of further information with regard to this.

BALDERTON, NEAR CHESTER.

In the year 1888, for the first time, a pair of Herons built and reared their young in the wood belonging to HIS GRACE THE DUKE OF WESTMINSTER. Unfortunately they have now abandoned the spot (1893.)

BURTON

(The Seat of Captain Congreve.)

This Heronry was established in 1857, and consisted of fifteen to twenty nests, which were built in some fir trees near the Marsh; but in the year 1880 part of the Heronry was blown down during a heavy gale, and the birds have not built there since.

HOOTON

(The Seat of Sir T. M. Stanley.)

This Heronry, I believe, was the oldest in Cheshire; I can get no information as to the commencement of it, although I have questioned some very old people who have lived there all their lives. These people still believe that the sitting bird puts its long legs through holes in the nest provided for that purpose. I need scarcely tell you that the Heron, when sitting, does nothing of the kind, as it can stow away its long legs under its body as well as a "Tom-tit." The Heronry consisted of about twenty nests, and, as far as I can make out, the number remained about the same for many years. Two years ago (1888), this Heronry was in a flourishing condition, but, unfortunately for the birds, the Manchester Ship Canal has gone quite through it. All the trees are cut down, and the necessary railroads, &c., have been made through what was one of the wildest pieces of woodland scene in Cheshire. I well remember paying a visit in 1887, and had it not been for a guide I must have lost my way, the bushwood being so dense it had overgrown the footways.

OULTON PARK

(The Seat of Sir Philip Grey Egerton.)

The only information I have been able to gather respecting this Heronry is contained in *Ormerod's Cheshire*, and I think I cannot do better than give the writer's own words: "A Heronry formerly existed here on an island in the pool, but was deserted about twenty years ago . . . . the approach to the house is of singular beauty, overshadowed by stately trees, amongst which the beech, for their size and luxuriance, are particularly conspicuous. The magnificent trees which now adorn the park and pleasure grounds, were, with the exception of the oaks and a few others, planted about 120 years ago, under the superintendence of the celebrated landscape gardener William Eames, and his pupil Webb."

Carden, near Broxton.

Contained in the *Cheshire Sheaf* I find the following reply to a Member of the Chester Society of Natural Science:—"The present Rookery at Carden was originally an extensive Heronry. I understand that William Leche did away with it, being so near the Hall, as the effluvia from the putrid fish-bones made it very objectionable Attracted by the trout stream and 'the pool,' Herons are still very frequent visitants. On one occasion it was impossible the fire in the 'Island Cottage' kitchen could be lit, and on examining the chimney the next day, the keepers discovered that the Herons had built it up nearly to the top." [Signed E. A. L., Clifton]

The last paragraph reads very curiously; it simply means that the fire in the "Island Cottage" kitchen could not be lit owing to the sticks in the chimney. As to the Herons carrying the sticks there, I don't believe it; most likely it was the work of a pair of Jackdaws, who sometimes build nests in similar situations, many feet long, to suit their convenience. If the Herons did build it "up nearly to the top," all I can say is that the chimney must have been some ten or twelve feet in diameter, or the birds would never have been able to have used their wings as a means of escape from the chimney, and their beaks could not very well have helped them out of the difficulty.

Tabley

(The Seat of Lord de Tabley.)

Ormerod, in his "History of Cheshire, 1880" (Vol. i., p. 623), says that "near to the lake a Heronry has been established." One might infer from this that it was established about the time of his writing, but it is probably of much older date. At the present time, "there are about fifteen nests at the Heronry at Tabley; they are built in a clump of chesnut trees overhanging the lake, in a secluded spot .... on the main land. Lord De Tabley strictly preserves the Herons, and no one is allowed near the spot at breeding time." [Geo. O. Day, in lit., Nov. 2nd, 1893.]

Combermere Abbey

(The Seat of Lord Combermere.)

Ormerod (l.c., Vol. iii., p. 406), says: "Owing to the havoc these birds made among the fish, the late Lord Combermere cut down all their trees some twenty or thirty years ago." The nests were built in some tall oak trees, on an island in the lake.

Mr. Boggins, the keeper, writes me under date January 21st, 1889:—"There is no Heronry here now; I have heard that the trees were blown down. There are not so many Herons here now as there were before the Ground Game Act came into force. The reason I give is that farmers shoot a great many at pits on the farms; there are now six or ten on the Mere. I sometimes see young ones, but there are no Heronries around here that I know of."

I think it will not be out of place to notify that Herons, as a rule, rarely fish near their breeding places. The Herons at Eaton fly miles in search of food, although plenty can be had at home.

Arley Hall
(The Seat of E. R. Warburton, Esq.)

On the eastern side of the mansion there is a large piece of water, near which this Heronry existed some forty years ago. Mr. P. Brown writes me (January 21st, 1889), that "the Herons ceased to build here about 45 years ago; people that lived here then tell me the rooks drove them away at nesting time."

Dunham Massey, near Altrincham
(The Seat of Lord Stamford.)

Mr. Harting (l.c.) gives a record of this Heronry, but does not state whether existing or not. Ormerod (l.c., Vol. i., p. 533) says:—"Forty or fifty years ago there was a Heronry here, built in some high trees near to some water with an island in it, called Dunham Pool. The birds appear to have abandoned the place in consequence of persecution and some of the trees having been blown down." At the present day its existence seems quite forgotten, as I have both written and visited the locality without being able to hear the slightest trace of its existence from the inhabitants.

Ince
(The Seat of Captain Park Yates.)

In the Marsh Plantation a few years ago, Herons used to build their nests in some tall oak trees. This plantation is still a favourite resort of the Heron, as is also another similar wood at Stanlow. I have seen scores of Herons congregated here in autumn; and odd specimens all the year round frequent these places, but they do not build there now, which is singular, as the locality seems a very suitable one.

Aston, near Frodsham.

This Heronry is situate in the wood adjoining the Hall, and was established about forty years ago by a single pair of Herons who built their nest in an ash tree near the Rookery. The late Mr. Henry Linaker told me, in 1888, that there were then about a dozen nests. He also informed me that the rooks and the Herons had many battles, apparently through the latter encroaching upon the Rookery. The rooks, however, managed to keep their adversaries at a respectful distance, and always came off victorious.

Through the kindness of MR. J. H. LINAKER, I have quite recently visited this locality—I cannot say Heronry, for alas! it no longer exists I saw the tall ash trees in which the Herons used to build, but there was not a stick left to tell the tale of their former existence. The keeper, who accompanied me, was under the impression that the Herons still built there, owing to the fact that he had seen a stray bird in the wood; but from what I could gather I should imagine that the Herons ceased to build in this locality about the year 1890. The strangest thing about the whole matter is that the rooks have also left, and there is neither Rookery nor Heronry. (May, 1893.)

NORTH WALES.

PLAS TREGAYAN, NEAR LLANGEFNI

(*The Seat of Major Lloyd.*)

The owner kindly informs me that the Herons first came here "about sixty years ago, and had about fifteen to twenty nests in beech trees close to the house. The rooks, of which there are a large number, used to fight them and pull down their nests, and have now driven them further off into some silver fir trees. I am sorry to say there are only about six or eight nests now." (January 21st, 1890.)

TREIORWERTH, NEAR VALLEY, ANGLESEA.

MISS WYNNE JONES (Chester) kindly gave me the following information respecting the Heronry at her late residence:—"About twelve years ago (1887), two or three pairs of Herons first commenced to build in a fir tree near the house, which in previous years had been tenanted by the rooks; the latter allowed the Herons to build their nests, and then drove them away; many struggles ensued, but the rooks came off victorious. Ultimately, the Herons built in some fir-trees a short distance away from the tree first selected. Three years ago the number of nests had increased to eleven."

Quite recently (May 27th, 1893), LORD STANLEY kindly writes:—"I saw a Heronry a few days ago at Treiorwerth. The young Herons were about to fly. I think most of the nests were in fir trees. I saw this Heronry about this time two years ago; the young Herons were then on the nests making much noise. This year the nests were not so plainly to be seen. The time before, when I saw them, I think I counted eight nests."

PENRHOS, HOLYHEAD

(*The Seat of Lord Stanley.*)

LORD STANLEY kindly informs me that "there is no Heronry now at Penrhos, but Herons used at one time to have one nest in the Beechwood at Alderley." (May 27th, 1893.)

VOELAS HALL, BETTWS-Y-COED

(*The Seat of Colonel Wynne-Finch.*)

MR. D. CAMERON writes: "I have been instructed by COL. WYNNE-FINCH to tell you all I know about the Voelas Heronry. They used to build formerly in a beautiful round clump of very tall beeches, but a few years ago they shifted to a spruce wood, not far from their old home, and they thrive so well in their new place that we have to keep them within bounds, being so destructive on the trout streams. There were about twelve nests last year, but not so many this year; but I am certain they would soon become very numerous if left alone, owing to the good shelter and the good supply of food. I have been asking the old keeper, who was here before me, about them. He says that there were about twelve nests in the year 1847, and more or less ever since, in the old Heronry" (May, 1893.)

BODRHYDDAN, FLINTSHIRE

(*The Seat of Capt. Conway.*)

MRS. CONWAY writes of this Heronry that "it was a very old one. The birds used to come regularly, about the 25th of January, all together. There were twenty or more nests, built in the big sycamores; they stayed till the young birds could fly, and then went away entirely till the following breeding season. The Herons left here when the pools in the grove were drained off. They built afterwards in a covert by the cottage, and remained there for about five years, until the trees were thinned about twenty years ago. Although the trees in which they built were left, they never returned."

ABERDUNNANT, TREMADOC

(*The Residence of Mrs. Jones Parry.*)

MAJOR LLOYD (Llangefni) kindly writes: "The Herons came here about ten years ago. They build in oak trees, and there are now about fifteen nests."

PENIARTH, TOWYN

(*The Residence of W. R. M. Wynne, Esq.*)

In a letter dated June 5th, 1893, the owner says: "There are only about seven nests this year, with about four young birds in each." I must here acknowledge my indebtedness to MR. WYNNE for the information he has furnished respecting other Heronries in North Wales.

Talgarth Hall, Machynlleth, Merioneth
(*The Seat of C. F. Thurston, Esq.*)

This Heronry is recorded in "The Field," March, 1872, by Mr. J. E. Harting, who says that fourteen pairs have nested here for the last fifty years. ". . . . . Although there are plenty of trees for them they do not increase in numbers, which is strange, as the owner does not allow them to be disturbed."

Major General White, the present tenant of Talgarth Hall, writes the agent, Mr. Chas. R. Kenyon, as follows: "There are about nine Herons' nests at Talgarth, and *all* in Scotch Firs. They are certainly increasing in numbers, and both rooks and Herons build on the same trees, and apparently live in peace." (June 4th, 1893.) In the foregoing it will be seen that there is a decrease in the number of nests since 1872; but it is satisfactory to learn that they are now increasing.

Benarth Wood, near Llandudno.

The late Mr. John Price, in his "Llandudno, and How to Enjoy It," says: "That a pair occasionally build here." [See also Pennant Record. Ante.]

Mr. Harry Thomas, of Llandudno, who has taken considerable trouble to gather information respecting the breeding places of the Heron near Llandudno, writes, that "the Heron no longer nests in Benarth Wood, or on the Little Orme."

Baron Hill, Beaumaris,
(*The Seat of Sir R. Williams Bulkeley, Bart.*)

Writes: "I beg to inform you that the Herons have not nested on this estate for the last twelve years; before that time a few Herons nested in a cover called Fryar's, about one mile from Beaumaris, and when they nested there their nests were on some tall silver fir trees. A few Herons still roost in Fryar's cover in the winter time."

Bramas Lodge, near Corwen.

Mr. Ruddy writes me under date November 5th, 1889, that "there was a small Heronry here about thirty years ago. The nests were built on the tops of larch trees, the tops being bent almost at right angles, forming thick flat platforms. The larches are there now, but the Herons left long ago." I learn that the reason these larches have their tops bent is owing to the prevailing winds, and not to the weight of the Herons' nests.

Flint.

Miss Lloyd, of Chester, informs me that Herons used to build here a few years ago. There is certainly no Heronry here now, and I fail to get further information. Mr. A. O. Walker writes—"I never heard of one, and doubt it very much."

Craig Llan, near Nevin, Pwllheli.

This is quite a new locality to me, and I do not know of any previous record. Lieut.-Colonel Wynne-Finch (Voelas) has written such an interesting account of this place that I have pleasure in giving his letter *in extenso*. He says: "Nevin is between seven and eight miles from Pwllheli, on the north coast of Carnarvonshire, and there is a rather remarkable rock, Careg-llam, some three miles N.E. of it, which rises nearly perpendicularly from the sea to a height of about 400 feet—rather less perhaps. At the base of this rock are caves in which there used to be (I have often seen them) seals, and on the ledges of this rock the sea and wild birds build in regular tiers.

"It is many years since I have been there, but I have seen them and watched them, and it is curious to see how the various kinds of birds keep to their own tiers. The Guillemots below, the various kinds of Sea Gulls and Cormorants below; Hawks, Peregrine Falcons, Ravens, and *Herons*, high up.

"In years gone by I have had many specimens of eggs given me which came from this place, though I hardly know how they got them, unless they were let down from above in a basket.

"I believe the place has of late years been a good deal disturbed by visitors or tourists, armed with guns, and fear the rarer birds must have been considerably thinned by the depredations of these people; but the rock still teems with wild birds, and is the most remarkable breeding place of the kind (except the Bass Rock) that I have ever seen in Great Britain." (June 5th, 1893.)

Rûg, near Corwen

(*The Residence of C. H. Wynn, Esq.*)

Mr. Thos. Ruddy informs me that "there is at present a Heronry existing here. The Herons come from this place to Palè, nine miles distant to fish, and also visit the Bala Lake for that purpose."

In revising this paper, Col. Evans-Lloyd kindly furnished the following information from the owner:—"There is a Heronry at Rûg of about one dozen nests, in some larch trees forming a clump. There is also a branch establishment started recently, close to the Rookery in the large wood facing the house, and about half-a-mile distant, but there are not more than three or four nests. (June 6th, 1893.)

Pennant Hall, in the Parish of Eglwys Fach,

(*The Residence of E. Williams, Esq.*)

The Rev. R. Williams, in "History and Antiquities of the Town of Aberconway" (Conway), says of the Heron:—"A pair occasionally builds in Benarth Wood; but there is a Heronry at Pennant, in the parish of Eglwys Fach, where they are numerous." (Published 1835.)

The owner of the Heronry says:—"The Herons still build their nests at Pennant, about twenty-five to thirty in number, upon the highest oak trees." (May, 1893.)

Some idea of the locality may be gathered from the following communication kindly forwarded by MR. A. O. WALKER:—"Pennant is a very out-of-the-way place, about half way between Eglwys Fach and Llanrwst, and lying in a romantic valley on the west side of a mountain called Mwdwl Ether."

GLYN HALL, HARLECH, MERIONETH,

(The Seat of Lord Harlech.)

In the *Zoologist*, 1873, p. 3369, MR. W. J. KERR gives a record of a Heronry existing here.

Through the kindness of MR. W. R. M. WYNNE (Penairth), I have received a communication from Lord Harlech's Agent, as follows:—"I have been up in the wood this morning, and could not find more than thirteen Heron's nests. Some of the young ones are flying about." (June 8th, 1893.)

PLAS-Y-WERN, NEAR RUTHIN.

MR. THOS. RUDDY informs me that a Heronry existed here in 1875, but I fail to obtain further information.

HENGWRT, DOLGELLY

(The Residence of Miss Lloyd.)

I must here again acknowledge my indebtedness to MR. W. R. M. WYNNE for the record of this Heronry. He says: "My brother tells me there is still a large Heronry at Hengwrt; but is unable to state number of nests." (June 10th, 1893.)

Subsequently CAPT. J. F. BAILEY writes: "At Hengwrt the Herons build in a wood on the side of a steep bank, and always on the oak trees near the top of the wood, overlooking all the others. They use about five trees, and there are from three to five nests in each tree. They *certainly* have two broods of young each year, and my keeper thinks sometimes three. He says: 'They are the first birds to hatch in the spring and the last in the summer.' He counted sixteen young ones together in one pool of the river early one morning this season."

HAFODGAREGOG, MERIONETHSHIRE.

"There were for some few years a few nests in a wood belonging to my brother, MAJOR PRIESTLEY, near Hafodgaregog, but they have quitted it, and returned to the place from where they presumably came, viz., Aberdunnant."

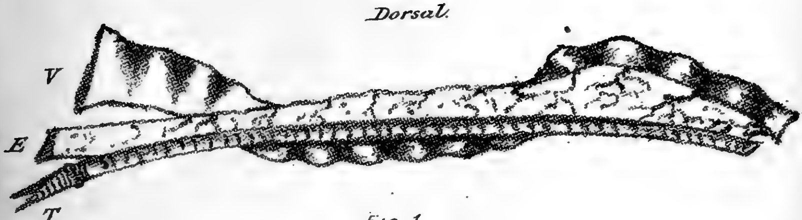


FIG. 1.

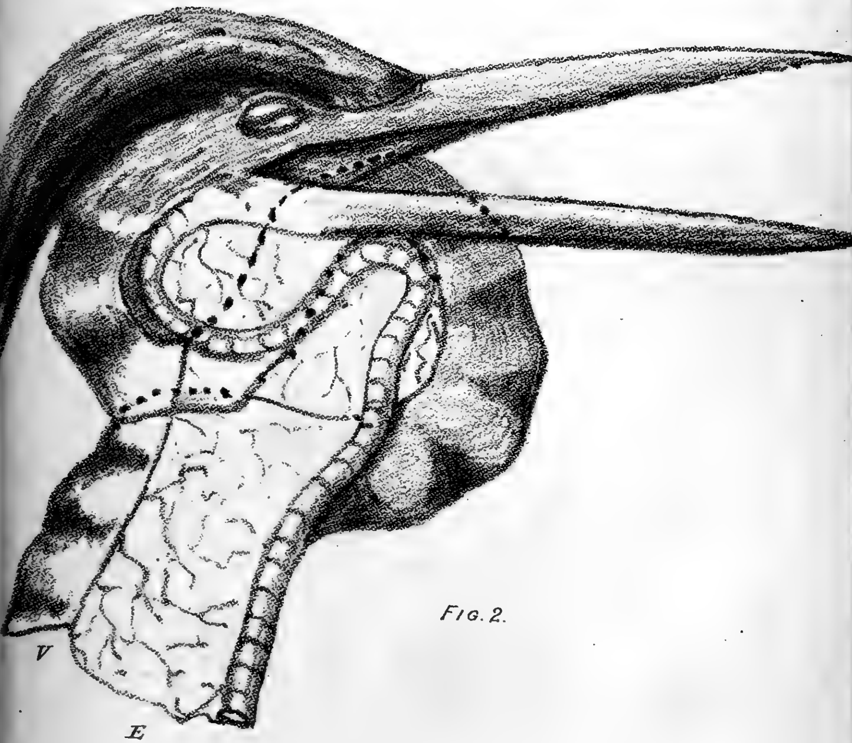


FIG. 2.

R. Newstead, del. et lit.

"They seem a most captious bird respecting their nesting; I know several instances of their starting fresh colonies, and then abandoning them, tho' treated with every consideration and respect—in other cases where a colony has been maintained in the face of obvious difficulties" (A. B. Priestley, *in lit.* 21, vi. 93.)

In conclusion, I can only say how very grateful I am to those who have so kindly furnished me with any information, without which the list would have been but poor. As it is, I fear it is anything but perfect. I can only add that any additional localities which may be notified will be most acceptable, and would be published without delay.

I am especially delighted to mention that in nearly every case the existing Heronries, both in Cheshire and North Wales, are strictly preserved by their owners. I am sure it is the wish of every true naturalist that the owners may continue to protect these noble birds, even although the sport they afforded in the past has long since died away.

EXPLANATION OF THE PLATE.

FIG. 1.—Neck of a Heron denuded of the skin and stretched to its fullest extent. *V*—Vertebræ; *E*—Esophagus; *T*—Trachea.

FIG. 2—Neck of a Heron in resting position. *E*—Esophagus, shewing direct course to the stomach; *T*—Trachea; *V*—Vertebræ.

A Preliminary List of the Mammals of Cheshire and North Wales.

BY R. NEWSTEAD, F.E.S.

(CURATOR OF THE GROSVENOR MUSEUM, CHESTER.)

IN my paper, "Notes of a Naturalist," read before the Society November 3rd, 1887, I gave several records, from my own observations, of local Mammals, with notes on their habits, &c.; these the Committee requested should be published in the Society's Proceedings. Since reading my paper the nature of my work has very materially prevented my making observations in the field; but I have had every opportunity afforded me of examining the specimens which have been presented to the Museum; these I have pleasure in adding to my list. Hitherto no list of the Mammals of our district has been published, and I feel that my own is far from perfect; but I trust that it will induce others to take the matter up, and supply the many shortcomings.

CHEIROPTERA (BATS.)

Family—*VESPERTILIONIDÆ.*

Long-Eared Bat (*Plecotus auritus*, Linn.) Widely distributed throughout the district, but not so common as *S. noctula*. I have frequently seen this interesting species hawking for flies in broad daylight, during the warm days of early spring.

Common Bat or **Flittermouse** (*Scotophilus pipistrellus*, Geoffroy.) This is the smallest and commonest species.

The Great Bat (*S. noctula*, Schreb.) Common, and generally distributed.

Daubenton's Bat (*Vespertilio Daubentonii*, Leisler.) I have seen a record of this species occurring in the old copper workings at Alderley Edge, but have forgotten the publication. I have not seen specimens.

Whiskered Bat (*V. Mystacinus*, Leisler.) There is a specimen of this species in the Society's Collection, which was taken by MR. CHAS. OLDHAM at Delamere, in August, 1893, under the bark of a fir tree. MR. OLDHAM records this species at Alderley Edge (*Zoo.*, 1889, p. 68.)

INSECTIVORA (INSECT EATERS.)

Family—*ERINACEADÆ.*

Hedgehog (*Erinaceus Europæus*, Linn.) Common.

Family—*TALPIDÆ.*

Mole (*Talpa Europæa*, Linn.) I have seen several specimens of a cream-colour, with the under parts golden yellow. There are three specimens of this pretty variety in the Museum collection; two from Nerquis Hall, near Mold, and one from Saltney, near Chester.

Family—*SORICIDÆ.*

The Shrew Mouse, or **Nurserow** (*Sorex vulgaris*, Linn.) Common. There is an albino in the Museum Collection, which was taken by MR. OWEN, at Picton, Cheshire.

Water Shrew (*Sorex fodiens*, Pallas.) In Cheshire I have seen specimens of this fine species at Ince, Elton, and Hatchmere. There is a specimen in the Museum Collection, from Padeswood, which was taken by MR. E. MYDDLETON.

CARNIVORA (FLESH-EATERS.)

Family—*MELIDÆ.*

The Badger, or **Brock** (*Meles taxus*, Schreib.) Thirty years ago this fine animal was common in Delamere Forest, on the Manley side of which there must have been a large colony of them, as traces of their burrows still remain, and the place is called "Boger Bonk" (Badger Bank) by the natives to this day. About the year 1885 a very old specimen was taken in the above locality by some poachers.

At Broxton (Badger Town) a few still remain; their burrows in this locality are on the side of a small hill sparsely covered with trees. There is a specimen from this locality in the Museum Collection which was taken in 1885. In 1888, one was dug out of a burrow at Oulton Park by a gamekeeper. The late Lord Robert Grosvenor informed me that a specimen was taken in the Belgrave Avenue, Eaton, Chester; this was in 1887, but I have not the exact date. In 1892, MR. PERCY ROBERTS, of Chester, possessed an adult female which was taken in the Cheshire Hills. In February of the same year she gave birth to *three* young ones; they only lived for a short time, however—the last one died when 127 days old; this specimen, through the kindness of MR. E. HODKINSON, is now in the Museum Collection. I do not know of the species occurring in North Wales, except at Vaynol Park, the seat of ASSHETON SMITH, ESQ., where I had the pleasure of seeing two specimens in captivity; both said to have been taken on the estate.

Family—*MUSTELADÆ.*,

Common Otter (*Lutra vulgaris*, Erxleb.) Common on the banks of the Dee. Sometimes specimens are seen as low down as the Dee Bridge, Chester, but it seems most common at Eaton and Farndon. Of frequent occurrence in the Weaver; in this river in the winter of 1892, five were seen together, and one of them shot which weighed 23 pounds. In the same year three were seen in the Gowy, at Stapleford; but I have never seen or heard of examples occurring at or near the mouth of this river.

Stoat, or **Ermine** (*Mustela erminea, L.*) White specimens of this common species are very frequent in Cheshire and parts of North Wales; there are three in the Museum Collection, as also a specimen in the transition stage.

I once saw one of these daring little animals rob a thrush's nest of its eggs. The nest was built in a yew tree some five feet from the ground, and I distinctly saw it bring down an egg in its mouth and lay it safely on the grass plot near the tree. When examined, the egg was found only to have the teeth marks of the animal in it; it was not otherwise broken.

Common Weasel (*Mustela vulgaris*, Linn.) Not so common as the preceding species.

Polecat, or **Fitchet Weasel** (*Mustela putorius*, Linn.) There is an adult specimen of this animal in the Museum Collection, said to have been taken in North Wales. Unfortunately, however, the label has been lost, and I fail to get any reliable information as to the locality.

MERIONETHSHIRE: In the *Zoologist* for 1892, pp. 74, 108, MR. C. H. CATON HAIGH, of Aber-ia, Penrhyndeudraeth, gives records of no less than nine individuals that were killed in the winters of 1890-91; and also states that he "saw in a fishmonger's shop at Dolgelly, a large bundle of Polecat's skins, said to have been procured in that neighbourhood, where, however, I was told that they were much less common than formerly."

The British Marten, or **Marten Cat** (*Martes Sylvatica*, Nilsson.) Although practically extinct in many parts of the country, I have seen no less than three examples of this rare animal in the flesh; all from the Society's district.

CHESHIRE: One in the Museum Collection was shot at Eaton, near Chester, on the estate of HIS GRACE THE DUKE OF WESTMINSTER, K.G., who very kindly presented the specimen to the Museum. MR. GARLAND (head-keeper) writes: "I send you a Marten Cat which was killed here yesterday morning, coming to the 'Pheasants' Field.' It is the first I have seen in Cheshire." (Dated July 8th, 1891.) The fur on the upper parts of this specimen is very dark brown, almost black ;) that on the throat decidedly yellow; and is undoubtedly referable to the *M. abietum* of Ray. MR. J E. HARTING, in his interesting article on the "British Marten" (*Zoologist*, 1891, p. 452), gives four records of its occurrence in Cheshire. One was killed early in the "forties," by "a game-keeper named Robinson, in the service of the Marquis of Westminster, at Whitley, not far from the old forest of Delamere." One was trapped at Hooton, in Wirral; another was taken alive "in the wooded district behind the hills at Frodsham;" and the fourth killed by fox-hounds in the neighbourhood of Eddisbury Hill, in the forest of Delamere. These are all old records, and I have no doubt that the Marten has long since become extinct in the Delamere Forest district.

A few days after the specimen was obtained at Eaton, as recorded above, another Marten was killed on the rabbit warren near Hope, and was afterwards preserved by MR. JARVIS, Taxidermist, Chester.

CONNAH'S QUAY: A very pale female, with a dusky-white throat, was taken here on the 14th of April, 1892, and which answers very well to the description of Gmelin's *M. foina*.

LLANFAIRFECHAN: A very large male was killed near here about the 28th of April, 1892; this was also a pale-throated form. For the two last records I am indebted to MR. T. HUTCHINSON, Taxidermist, of Chester, who very kindly allowed me to examine the specimens while in the flesh.

Below I append the measurements of three of the above specimens :—

	Total length.	Head.	Tail.
Eaton Specimen	28½ in.	3½ in.	10½ in.
Connah's Quay do. ..	25¾ in.	3½ in.	9½ in.
Llanfairfechan do. ..	29 in.	4 in.	11 in.

In concluding my notes on the Marten, I must again refer to MR. J. E. HARTING (*Zoo.*, 1893, p. 162), to complete the North Wales records. At Llanberis one was killed in 1845, and is said to have been common at that time. "About the end of 1879, three were killed in the neighbourhood of Beddgelert;" and "two were trapped in February, 1890, on Lord Penrhyn's moors, by Conway Lake." I would strongly advise the reader to refer to MR. HARTING's original articles (*l.c.*), as the above are only brief extracts from the author's very interesting account of this almost extinct animal.

Family—*CANIDÆ*.

FOX (*Canis Vulpes*, Linn.) I think most abundant in the Delamere district, in Cheshire.

RODENTIA.

Family—*SCIURIDÆ.*

Squirrel *(Sciurus vulgaris,* Linn.) Common in Cheshire; especially so in the Delamere Forest district. I know very little of its distribution in North Wales, but it is common at Colwyn Bay.

Family—*MYOXIDÆ.*

Common Dormouse *(Myoxus avellanarius,* Linn.) My father (MR. R. NEWSTEAD, SENR.) found a specimen of this elegant species in the hollow of an old appletree, at Thornton-le-Moors, in the autumn of 1885. This is the only record that I know of for Cheshire, which I believe is quite unique.

My first acquaintance with the species in North Wales was at Nant-y-Glyn, Colwyn Bay, on the 23rd of June, 1885, and this in a very extraordinary way. MR. A. O. WALKER and I had "sugared" a number of trees in his wood for *Lepidoptera*; and, after doing so, stationed ourselves near the first tree, that we might be better able to judge when the moths were out. On making the first examination of the tree, I saw something large move away from the strip of "sugar;" I quickly retraced my steps and communicated the fact to MR. WALKER who was "netting" higher up the wood. After waiting about five minutes we "lit up," and very quietly approached the tree again. Turning the light gently on to the sugar we distinctly saw a mouse of some kind sitting at the very edge of the strip of sugar; a dexterous stroke of my net-stick brought the little fellow to the ground, when, to our astonishment, we found it to be a full-grown specimen of the Dormouse.

The unexpected often happens at "sugar." A big bull once licked every bit of the sugar of a tree that I had "painted," and by his manners caused me to beat a quick retreat; this, I believe, has been the experience of the Entomologist on more than one occasion, but I never heard of a Dormouse being attracted by "sugar." *

Subsequently, I have seen two or three other specimens from the same locality; one of them, curiously enough, was found in its nest, which had been blown from its winter quarters in an adjoining hedge.

Family—*MURIDÆ.*

Harvest Mouse *(Mus minutus,* Pallas.) There was a specimen of this small species, together with its nest, in the *local* collection of the Society—unfortunately without a label; but I believe there is no doubt as to its having been taken from some part of the Society's district. The nest is fixed to the stems of the "Hard Head" *(Centauria nigra)*, and is

* A mixture of treacle and rum, used for attracting Moths.

still preserved in the Museum Collection; but the animal, for want of attention, was destroyed by "moths" before the collections were removed to the present building.

Long-tailed Field Mouse (*Mus sylvaticus*, Linn.) A common and very injurious species to the early crops of peas in gardens. There is a curious pale-buff variety of this species in the Museum Collection, presented by MR. CRUM, Broxton Old Hall, Cheshire, who obtained it on his estate.

Common House-Mouse (*Mus musculus*, Linn.)

Old English Black Rat (*Mus Rattus*, Linn.) Aldersey, Cheshire, seems to be the only habitat for this species in the Society's district. There is a very poor immature specimen from Aldersey Hall in the Museum Collection, and a fine example from Widnes, which is just beyond our borders. It is now about five years since I heard of the species at Aldersey; at that time a resident told me they were then fairly common.

Common Brown or Norway Rat (*Mus decumanus*, Pallas.) My friend MR. STORRIE, the late Curator of the Cardiff Museum, informs me that this persistent pest is getting the worst of it at Cardiff; or at any rate the black indigenous species has undoubtedly increased

Family—*ARVICOLIDÆ.*

Water-Vole (*Arvicola amphibius*, Linn.) Abundant; in the marshy districts of Thornton-le-Moors, Ince, and Frodsham, I have frequently seen almost black specimens of this species.

Common Field-Vole (*Arvicola agrestis*, Linn.) At Ince, Cheshire, in July, 1882, a large hay-field was so completely infested with this species that I can compare it, on a smaller scale, to nothing short of the "Scotch Plague" of 1892; nearly every foot of ground was traversed with their runs, and the animals simply swarmed. There is an albino specimen in the Museum Collection from Nantwich, presented by MR. W. SMITH. Also two pretty pied varieties, both taken from a nest at Cotton Edmunds, near Chester.

Red Field-Vole (*Arvicola glareolus*, Schreber.) Probably commoner than is supposed; owing to its close resemblance to the former it is undoubtedly often overlooked. We are considerably indebted to the REV. C. WOLLEY DOD for the Museum specimens. He writes from Edge Hall, Malpas, October 30th, 1891: "I send three specimens of *Arvicola riparia*, Yarrell, caught in my garden last night. The species is common enough, but not sufficiently distinguished by ordinary observers from *A. agrestis*, which is less easy to trap with cheese, the ordinary bait." I have not observed specimens in a state of nature, nor do I know of any other locality.

Family—*LEPORIDÆ*

Common Hare (*Lepus timidus*, Linn.)/

Rabbit (*Lepus cuniculus*, Linn.) I have seen two very extraordinary cases of malformation of the incisor teeth, owing to a curious deformity of the jaws, both of which are in the Museum Collection. The one, received from Mr. A. C. Wolley Dod, has the left lower jaw contracted, so that the right lower incisor (*Scalpyriform incisor*) is brought to bear on the left upper incisor, consequently leaving the two remaining incisors free, with the result that they have grown to twice their natural length, and are curved outwards. The second example, received from Mr. R. J. Smith, of Aldford, is still more extraordinary. In this example the four incisors have all grown to an enormous length, especially the right lower one, which reaches to the top of the nose, and measures 1¼ inches; the opposite upper tooth has taken an unfortunate direction, curving inwards into the mouth, which must have given the animal great pain, and rendered mastication almost impossible. Curiously, in both examples, the inner or *accessory incisors* had not grown very much beyond their usual length. How these animals existed with such a dentition is extraordinary, and more especially so as they were both full-grown animals.

RUMINANTIA.

Family—*CERVIDÆ.*

Fallow Deer (*Cervus dama*, Linn.) Semi-domesticated.

Family—*BOVIDÆ.*

White Wild Cattle (*Bos taurus*, Linn., var. *Scoticus.*) There is a fine herd of these animals at Vaynol Park, Carnarvonshire, the property of Assheton Smith, Esq., which the Members of this Society had the privilege of seeing in 1891, by kind permission of the owner. The once celebrated herd at Lyme, in Cheshire, have become extinct. I cannot do better than refer the reader to Mr. Chas. Oldham's article in the *Zoologist* for 1891, pp. 81-87, which gives a full account of the herd.

CETACEA (Odontoceti.)

Family—*DELPHINIDÆ.*

Porpoise (*Phocæna Communis*, F. Cuvier.) Sparingly off the Welsh Coast. A specimen taken at Colwyn Bay in November 1891 was presented to the Grosvenor Museum by Mr. A. O. Walker. I have seen many specimens off Bull Bay, Anglesea, and they often occur in the Mersey below Eastham.

In *The Fauna of Liverpool Bay* (Rept. ii., pp. 134-51), the late Mr. T. J. Moore has given a "Report on the Seals and Whales (*Pinnipedia and Cetacea*)," of the district, containing much interesting information.

LIST OF PARASITES TAKEN FROM VARIOUS MAMMALS IN THE SOCIETY'S DISTRICT :—

APHANIPTERA (FLEAS.)

Hystricopsylla Talpæ, Curt. Two in nest of Field-Vole, Huntington Woods, Chester.

Tryphlopsylla octactenus. Several on Common Bat (*S pipistrellus*.)

„ *hexactenus*. „ „ „

„ *assimilis*. Two in nest of the Common Mole, Lache Eye, Chester. In the same nest, or rather the nest cavity, was a full-sized Toad; like myself, was he there hunting fleas? Perhaps the Mole ploughed him out of his hiding place.

Pulex leporis, Leach. Swarmed on several specimens of the Common Fox. This is the same species which infests the rabbit.

P. schiurus. Three specimens from the Pine Marten, recorded above, from Connah's Quay. MR. E. SAUNDERS, to whom I am indebted for the verification of all the species, says it is identical with that which infests the Squirrel.

ACARINA (MITES.)

Gamasus terribilis, Michael. Many specimens from the same mole's nest the fleas (*L. assimilis*) occurred in, and to which it is a veritable enemy. As they were taken, the fleas and mites were placed together in a small glass tube; I soon found separation necessary, as a big *Gamasus* immediately attacked one of the fleas, and before I could separate them the unfortunate flea had lost its abdominal segment, and the life-giving juices of its body: probably mixed with blood *corpuscles of Talpa*. How fortunate it would be if *Pulex irritans* had such an enemy!

"Ticks" (*Ixodidæ*.) The Badger in the Museum Collection, when received in the flesh, simply swarmed with a somewhat small species; so much so that it was necessary to kill them with a good dressing of turpentine. Unfortunately, I did not preserve any of the specimens, and so the record, in a way, is lost to science.

The Hedgehog is occasionally infested with a very large species; as also the Stoat; but I am unable to identify any of the species.

Subterranean Erosion, and some of its effects.

BY W. SHONE, F.G.S.

Read January 7th, 1892.

ON December 9th, 1891, I read a paper before the Geological Society of London, entitled "Subterranean *denudation*, &c." In the discussion which followed, there was a consensus of opinion that Subterranean *erosion* was the better definition of the two. It was argued that *denudation* was the act of laying *bare*, and could not therefore be *subterranean*. The objection to the word *denudation* was too obvious to be disregarded, though, I confess, the substituted word *erosion* is apt to lead to misunderstanding between *subærial* erosion and *subterranean* erosion if we do not clearly comprehend that the former works from *without* inwards, and the latter works from *within* outwards. Subterranean erosion has consequently nothing to do with the undermining from without-inwards of our coasts by the action of the sea—or inland that of rivers—along their banks.

Subterranean Erosion.

Subterranean erosion may be either chemical or mechanical in its action. The removal *in solution* of rock material from beneath the surface by springs is too well-known to need any further comment. The matter removed is, however, so infinitesimal in bulk as to require a great lapse of time before it can produce any perceptible physical effects.

Mechanical Subterranean Erosion.

It is very different with the mechanical action of subterranean erosion. We must bear in mind that water cannot remove any solid matter of greater specific gravity than itself, unless it forces it *along an inclined plain*.

The mechanical power of subterranean erosion must vary with the angle of inclination along which the underground water flows—the character of the strata through which it moves, and the hydraulic pressure or "head" which impels it forward towards the point of escape. With such varying factors we may expect very divergent effects. All other things being equal—

the nearer the underground water approaches the point of escape, the greater becomes its power of subterranean erosion; and decreasing in its power, from the point of escape *inwards*, in inverse ratio towards the underground watershed. This results in that *lateral subsidence* which is so characteristic of subterranean erosion. In the Sandgate disaster *lateral* subsidence was a very marked feature.

By way of a local illustration we may take the following section from Ithell's sandpit, Upton, Chester, to the Chester and Birkenhead road, a distance S.S.E. to N.N.W. of 480 yards, across two valleys cut out of the Glacial Drift.

Along the line of section at B–B the sands and gravels crop out from under the clay. At such points springs are of frequent occurrence, and if these are caught in troughs deposits of sand quickly accumulate in the receptacles. After heavy rains the quantity of sand deposited by even tiny springs is very considerable.

Where the drainage is insufficient to maintain permanent springs, a stratum of a soft puddly nature is produced by the constant oozing-out of underground water. There are other outlets which are active only during the continuance of very heavy rain, acting as storm-overflows for the ordinary underground drainage.

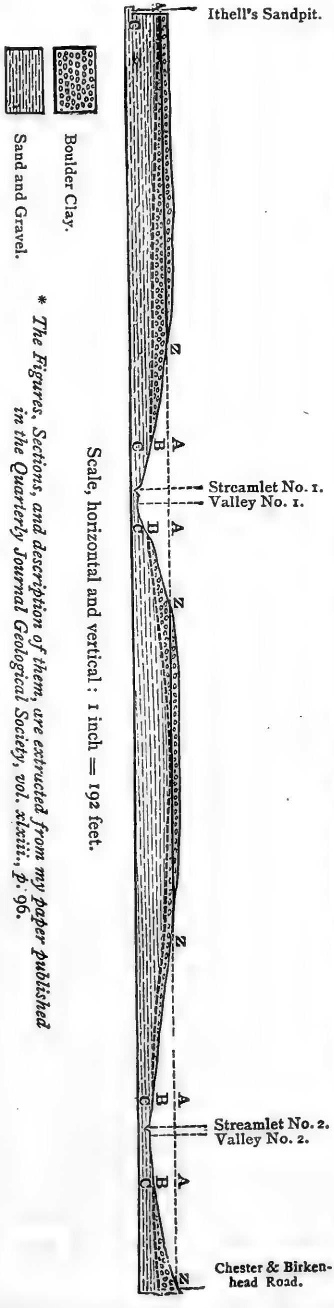


*Fig. 1.—*Section from Ithell's Sandpit, Upton, Chester, to the Chester and Birkenhead Road.*

Scale, horizontal and vertical: 1 inch = 192 feet.

* *The Figures, Sections, and description of them, are extructed from my paper published in the Quarterly Journal Geological Society, vol. xlxiii., p. 96.*

One and all, however, issue from underground charged with matter derived from the subterranean erosion of the clays, sands, and gravels under or through which they have passed, Waste so constant cannot have continued for a long period of time without leaving evidences of its effects.

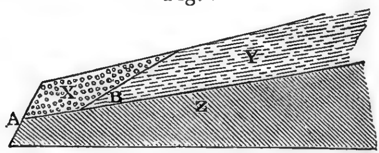
For instance, in Ithell's sandpit (see fig. 1), the sands and gravels beneath the Upper Boulder Clay have been proved for 30 feet without reaching the rock (Bunter Pebble-beds.) If the clay, sand, and gravel were of a uniform thickness across the whole line of section from S.S.E. to N.N.W., the clay would be upon the horizon A–A, and the sand and gravel should crop out at Z–Z instead of at B–B. It should be noticed that the height of the clay from ridge to ridge is uniform throughout, so that an observer at either end has an uninterrupted view across.

If A–A represents the former line of junction of the clay with the sands and gravels, the latter must have been removed to the extent of the difference between A and B, the present outcrop in each valley. In valley No. 1 the clay has subsided 18 feet, and in valley No. 2, 30 feet. The total length of the section is only 480 yards.

It is characteristic of subterranean erosion that its action is lateral; it is greatest at the point of escape and least at the farthest distance from it, while the interval between these two extremes becomes an inclined plane of subsidence. I believe this fact accounts for the occurrence of the present outcrops of the sands and gravels in the section at B–B instead of at Z–Z, the difference being the measure of the subterranean erosion of the Drift.

Subterranean erosion is frequently intermittent, and especially so if an impervious stratum rests upon a pervious one. Thus, the accompanying diagram (fig. 2) illustrates a very familiar example.

Fig. 2.

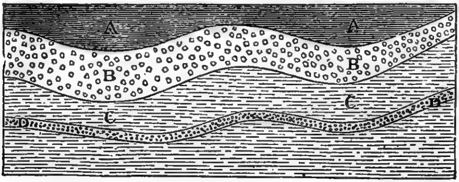


X. Clay. Y. Sand and Gravel. Z. Rock.

The overlying clay, by the removal of the sands and gravels between A and B, has brought down the clay X upon the rock Z, effectually stopping any further subterranean erosion until the barrier of clay between A and B has been removed by subaërial denudation.

The sands and gravels beneath the clay are not eroded in a uniform manner, the finer sands and gravels being most easily removed. The stratification of these beds is most variable, and current-bedding very frequent, this giving rise to constantly changing deposits of light sands intermingled with beds of coarse sands and gravels on the same horizon. In sandpits it may be often observed that the surface-soil is of very unequal depth, as in the following diagrammatic section of Ithell's sand-pit at Upton, Chester:—

Fig. 3.



A. Surface soil.
B. Boulder Clay.
C. Sand and Gravel.
D. Bunter Sandstone pebbles.

The soil A–A rested on the undulations of the Upper Boulder Clay B–B, and the latter on the undulating surface of the Middle Sands and Gravels C–C, whilst a curved layer of local pebbles of Bunter Sandstone (D) followed the curvature of the beds A, B, C. These lines of curvature, so frequent at the junction between the Upper Boulder Clay and the Middle Sands and Gravels, have been often, I think, erroneously interpreted as evidences of unconformity, contemporary erosion, or contortion. I venture to express the opinion that such appearances are in the vast majority of instances the results of the subterranean erosion of the heterogeneous deposits of the Glacial Drift.

If it be established that the Drift sands and gravels commonly occurring under the Upper Boulder Clay have been subject to subterranean erosion, thereby causing a lateral subsidence of the clay, it follows that in low-lying districts submerged Peat and Forest-beds would be the natural consequence. Such conditions do prevail along the low belt of land forming the coast-line of the N.W. of England and Wales, from Lancaster to Great Orme's Head, and submerged Peat and Forest-beds are matters of common occurrence. After storms, remnants of such beds are often laid bare between high and low-water marks along the whole of this coast, and between the Ribble and the Dee these exposures have been watched and noted by careful observers for many years. Perhaps the best sections are those exposed from time to time between the Dee and the Mersey, on the Cheshire shore at Leasowe.

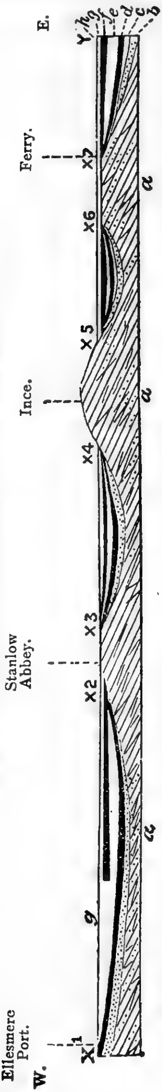
Mr. G. H. Morton, in the first edition (1863) of his 'Geology of the Country around Liverpool,' gives a section of the Peat and Forest-beds at the locality mentioned.[1]

The strong resemblance which Mr. Morton remarks between the Peat and Forest-beds and the Coal Measures may be due to like causes in the past and present. In other words, what will explain the origin of submerged Peat and Forest-beds may also be helpful in clearing away many difficulties in connexion

[1] *Op. cit. p.* 48.

with the origin of Coal-beds. Mr. Morton further states that on "approaching the embankment from Dove Point, the two lower old Forest-beds gradually amalgamate, and then both are represented by one carboniferous bed; the three feet of silt between having thinned out until lost."

Fig. 4.—*Section from Ellesmere Port to Ince Ferry.*



a. Lower Pebble-beds. *b.* Boulder Clay. *c.* Upper Drift Sand. *d.* Lower Peat and Forest-bed. *e.* Blue Clay. *f.* Upper Peat and Forest-bed. *g.* Recent Tidal Silt. *h.* Present Surface.

The section given by Mr. Morton in his admirable second edition (1891) of 'The Geology of the Country around Liverpool,' on the Manchester Ship Canal between Ellesmere Port and Ince Ferry, will I think, throw much light upon the section at Dove Point, now unfortunately destroyed by the encroachments of the sea.

Mr. Morton states that the Peat and Forest-beds "occur in the depressions between the rock-exposures, and they extend with little variation along the middle; but as they approach the sides and ascend the slopes they become thinner, and gradually end before reaching the rock" (p. 265.) He also states that "there is frequently a difference in the height of the peat on opposite sides of the Canal, and constant indications of the varying contour of the old land-surfaces; but it is evident that those of the rocky eminences have been continuous with the lower and upper beds of peat" (*loc. cit.*) Having carefully watched the progress of this section of the Canal, I can testify to the accuracy of Mr. Morton's observations. He has kindly allowed me to make use of this section; and I am greatly indebted to him for this favour, because it enables me to base my explanations of the causes of submerged Peat and Forest-beds upon his independent observations. However opposite, therefore, my conclusions as to the causes of submerged Peat and Forest-beds may be to his, there is no difference between us as to the stratigraphical position or description of the section.

The section of the Ship Canal from Ellesmere Port to Ince Ferry is about three miles long, and is cut through marshes forming the left bank of the Mersey, into which they drain. The section exposes the solid basement upon which the Glacial and post-Glacial beds repose. Mr. Morton gives the following details of the section at Ince Ferry:—

		ft.	in.
Recent Brown and Blue Clay		5	0
Post-Glacial	Upper Peat and Forest-bed	5	0
	Blue Clay	10	0
	Lower Peat and Forest-bed	1	3
Glacial ——	White sand, on Boulder Clay	10	0
		31	3

On referring to fig. 4, it will be seen that in the short distance between X^7 and Y the Peat and Forest-bed bifurcates into Upper and Lower Peat and Forest-beds, with a wedge-shaped deposit of Blue Clay 10 feet in thickness at Y and rapidly thinning out towards X^7. Along the whole line of section, at the points X^1 to X^7, the Upper and Lower Peat and Forest-beds become united, and at these places, it should be noticed, they rest close upon the rock.

Whatever, therefore, was the cause of the submergence of the Peat and Forest-beds between X^1 and X^2, X^3 and X^4, X^5 and X^6, X^7 and Y, it did not disturb the continuous growth of the united Peat and Forest-beds at the points X^1 to X^7. The conclusion to my mind is inevitable that, whatever caused the submergence of the Peat and Forest-beds in the hollows between the bosses of Bunter Sandstone could not have altered the level of the solid basement of rock on which the Peat and Forest-beds repose. That conclusion would require the abandonment of the generally-accepted theory that post-Glacial submerged Peat and Forest-beds are evidences of changes of level due to a downward movement of the solid basement of rock upon which they rest. If no such movement has taken place, then the operative cause must be one that could act similarly, yet independently, within the limited area of each rock-basin between Ellesmere Port and Ince Ferry.

It must be borne in mind that the Ship Canal along this line of section runs parallel with the Mersey and intercepts the drainage of the marshes into it. During the construction of this section of the Ship Canal serious landslips have occurred. They have been confined, so far as my observation extends, principally to the land side of the cutting, or that side which receives the drainage percolating from the higher ground towards the River Mersey. Powerful pumping-engines were stationed at short intervals and kept working day and night in order to keep the cutting clear of water. Have we not here a sufficient explanation of the submerged Peat and Forest-beds?

The mingled Peat and Forest-beds increase in thickness towards the centre of the rock-basins formed by the Bunter Sandstone bosses of Ellesmere Port, Stanlow Abbey, Ince, and Ince Ferry. Through these four channels the subterranean drainage of the land in the rear of the section escaped into the River Mersey. The underground water must accumulate most in the centre of each rock-basin, and consequently exert its greatest force in the lower portions of each hollow, with the result that the mingled Peat and Forest-beds would increase in thickness towards the centre of each rock-basin until submerged and buried under the Blue Clay which divides the Upper and Lower Beds.

In brief, the stratigraphical history of this most interesting section appears to me to be as follows:—The Lower Forest-bed flourished upon Glacial Drift very little above the water-level of the district. By subterranean erosion the level was gradually lowered between the points X^1 and X^2, X^3 and X^4, X^5 and X^6, X^7 and Y, until the site of the forest became a peat-morass, which was eventually covered with Blue Clay. The time came when the drainage was interrupted and subterranean erosion ceased; then the Upper Forest-bed spread out from the points of continuous growth (X^1 to X^7) across each rock-basin. It flourished until the cause of the interrupted drainage was removed, when subterranean erosion again became active, and the Upper Forest-bed sank below the water level, while peat-mosses grew on its site, until in turn they were buried under tidal silt—the rate of subterranean erosion at present being more rapid than the increase of the thickness of the peat by growth.

The principal characteristic of subterranean erosion is *lateral* subsidence. *Intermittent* action follows as a natural consequence. This is especially the case when an *impervious* bed rests upon a *pervious* one, as in fig. 2. The liability of subterranean erosion to be interrupted along any inclined plane of underground drainage, is, in my opinion, the cause of the bifurcation of the Peat and Forest-beds; while the thinning-out of the deposits which separate them into Upper and Lower towards each point of bifurcation shows that the subsidence in each case was gradual and lateral.

Mr. T. Mellard Reade published in the "Proceedings of the Geological Society of Liverpool," for 1871-72,* a number of very valuable sections of the post-Glacial deposits of Lancashire and Cheshire, from which the general tendency of Peat and Forest-beds to subside laterally is very obvious.

After the publication of my paper on "Subterranean Erosion," in the Quarterly Journal of the Geological Society, Mr. G. H. Morton, F.G.S.,† called attention to the fact that the late Mr. John Cunningham, F.G.S., in a paper read before the British Association, in 1854, "On the Submarine Forest, Leasowe," had come to very similar conclusions to myself, with regard to

* *Op. cit.* p. 36 *et seq.* and plates ii.-iv.
† *Geological Magazine*, September, 1892.

the cause of submerged forests on the Lancashire and Cheshire coasts. He, however, confined himself to this particular area. He does not appear to have suspected the widespread action of subterranean erosion, such as I have indicated. He connects the phenomena with the action of the sea, and overlooks the much wider action of subterranean erosion inland, as for example exhibited in fig. 1:—18 miles from the sea, and 100 feet above O.D., caused by the underground drainage into brooks, which tap the quicksands in the Glacial Drift as they cut their channels deeper and deeper. The section given at fig. 1 might, in the drift covered areas of Lancashire and Cheshire alone, be repeated hundreds of times.

As the question of subterranean erosion is attracting attention, it is desirable to republish *in extenso* the abstract of the late Mr. John Cunningham's paper on "The Submarine Forest, Leasowe," in "The Report of the British Association for 1854." It will also enable any student of the subject to see how far Mr. Cunningham had anticipated me.*

"On the Submarine Forest, Leasowe.

By John Cunningham, F.G.S.

A section of the strata of the alluvium to the depth of 56 feet was exhibited in the following descending order, viz.:—

First boring on the Marsh.

Surface.

28 feet.	2 ft.	Sand.
	4 ft.	Peat in which the trunks of trees are imbedded.
	2 ft.	Stiff blue clay in which the trees grew.
	16 ft.	Red clay intermixed with turf at top, below with blue veins and sand veins.
	4 ft.	Quicksand penetrated to the depth of 4 feet only.

Second boring about 8 *feet under the surface level of the Marsh outside of the base of embankment.*

10 ft.	Red clay mixed with blue veins and sand.
38 ft.	Brown clay with sand beds from 2 to 3 inches thick, and from 5 to 7 feet apart.

* See also Lyell, C. *Principles of Geology*, ed. 2, vol. i., p. 310; vol. ii., p. 275.

The circumstance of trunks and roots of large trees being fouud below low-water level, has induced a belief that a subsidence of the shore at Leasowe, the opposite shore at Formby, and of the estuary of the Mersey has taken place from deeply-seated subterranean action similar to what is now going on in the south of Sweden.

If the subsidence of those places referred to be due to deeply-seated subterranean action, then the rocks at New Brighton lying a little way to the south of the space operated on, as also Hilbre Islands and Hilbre Point, the latter immediately adjacent to the submarine forest, all composed of the new red sandstone, would have manifested some degree of sympathy with the area under the depressing influence, but no such evidence exists in any of those places. They maintain the same elevation they had centuries ago, while, on the contrary, the shores adjacent are known to have subsided several feet within the last thirty years. The cause of this subsidence must therefore be referred to some other operating agent or agents than to subterranean action.

The borings recently made under his superintendence, of the strata in the alluvium shown in the sections, prove their permeability to water, being composed of sand and clay beds alternately to a very considerable depth.

The abrading action of the tidal currents on the edges of the strata prepares a ready means of escape for the water and sand from underneath the clay during the refluxes of the tides, and the hydraulic pressure of the water at a higher level in the permeable strata, forces the sand from underneath the clay beds; hence the subsidence of the shore, &c.

The clay bed near the surface in which the trees grew, together with the superimposed peat or vegetable matter, resist the abrading power of the water longer than the other materials. They therefore remain on the surface and descend conformably, with the lower strata undermined, and consequently become submerged even under the level of low water.

Abrasion of the surface of the shore takes place also to a considerable extent by the alternate frosts and thaws that occur during the winter months.

The submarine forest on the Formby shore is supposed to be due to the same causes that operate at Leasowe.

A section was shown of Bidston Marsh, which forms a continuation of the flat shore at Leasowe, having also the remains of an ancient forest imbedded in peat in a similar manner. The levels taken of the surface upon which trees now grow in the S.E. corner of the marsh, and of the surface upon which the roots of the ancient trees exist, prove the difference to be only 18 inches, *i.e.* the surface upon which the living trees now grow is 18 inches higher only than the surface upon which the forest trees flourished, and therefore MR. CUNNINGHAM conceived that forest trees could flourish as luxuriantly on the present surface of the marsh as those of the ancient forest.

MR. CUNNINGHAM had entered into some speculations as to whether the extensive flat lands on both sides of the estuary were encroachments of the land upon the sea, how far those encroachments extended, or whether the whole of the flat lands were not simultaneously elevated to their present level. These questions, although interesting and intimately connected with the subject of the submarine forest, were left for future consideration."

That water exists under the Boulder Clay at considerable hydraulic pressure can be demonstrated. At Helsby (Cheshire) there are several wells in Boulder Clay, which as soon as water was struck it rose to the surface, and has in each case continued to overflow ever since.

MR. STRAHAN, M.A., F.G.S., mentions similar overflowing "wells near the Welsh border."*

"Broughton; Well-house Farm." Above Ordnance datum about 22 feet.

Sea sand and loam..............	12 feet
Boulder Clay	72 ,,
	84 ,,

"Water overflowed at the surface"

Again at "Dodleston; the Rectory Well." Above Ordnance datum about 55 feet.

Clay and sand......	145 feet

"Water overflows all the year round."

MR. STRAHAN refers also to several others.

That underground water communicates with the sea is proved by MR CLEMENT REID, F.G.S., who states that "at Bridlington a boring in the harbour yields a good supply of water. The quality is excellent, though the level rises and falls with the tide. South of the harbour there is another well, connected with a stand-pipe. This yields no water at low tide, but about half tide it commences to flow, and continues till the tide again falls to the same level. The spring in the harbour is largely used for the supply of the town, and is preferred to the natural springs."†

These phenomena clearly indicate a flow of the underground water towards the sea. The fact that peat and forestal remains have occurred below low-water mark is a proof that subterranean erosion is not limited by tidal influences. We have seen that

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* *Memo. Geol. Survey.* "The Geology of the neighbourhood of Flint, Mold, and Ruthin," pp. 221-2.

† *Memo. of the Geol. Survey.* "The Geology of Holderness, &c.," p. 129.

in the low-lying drift-covered areas, underground water exists under great hydraulic pressure. If such water makes its way to the sea, it could escape far below low water. I am strongly of opinion that quicksands on our shores are caused mainly by the subterranean drainage from the land; they are in fact the points of escape where the *underground waste oozes out.*

It must not be supposed that because I have chosen to illustrate the subject of subterranean erosion from a local standpoint, that its effects are more or less local. It is far otherwise, as the disaster at Sandgate, Kent, only too plainly portrays.

In the *Quarterly Journal of the Geological Society*, vol. xlviii., p. 103, I defined subterranean erosion as follows:—"That *wherever* water percolates through such unconsolidated beds as clays, sands, and gravels, *along an inclined plane*, it is constantly carrying the lighter materials of such strata towards the *nearest point of escape. The nearer the approach to the point of escape*, the *greater* becomes the *power of subterranean erosion.* This action *causes lateral* subsidence.

All other things being equal—if subterranean erosion be true at all—it will prove as true in the past as in the present, and as wide in its operations as the law of gravitation. I maintain—*inter alia*—this "principle of geology" may be responsible for such widely separated physical phenomena as the submerged Peat and Forest-beds of the Estuary of the Thames; the Dismal Swamps of America; the contorted Drifts of Norfolk; or the thick coals of South Staffordshire."

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NOTE.—I have to thank the Council of the Geological Society for allowing me to take "clichés" of the figures and sections which are reproduced in this Paper.

[*The following appeared in the Geological* Magazine *for July*, 1893, *p.* 323.]

The Cause of Crateriform Sand Dunes and Cwms.

BY WILLIAM SHONE, F.G.S.

AT St. Anne's-on-the-Sea, Lancashire, there are a great number of very large sand-hills. They are for the most part crateriformed in the centre, from the gyratory movement of the wind in stormy weather There must be some cause, however, which determines the course of the wind, for its natural action, one would suppose, should be to carry away Dunes by sweeping them before it.

I believe the *initial* cause of crateriform sand Dunes is rain. The Dunes are so porous that the rain does not run off the outsides, but sinks through them, carrying particles of sand with it as it sinks to lower levels This is especially the case when the base of the sand-hill rests upon quicksand. The internal abstraction of sand is greatest in the centre and least at the sides, hence the formation of a *central initial* cup.

During the wet season in September and October, 1892, I had many opportunities of studying such phenomena at St. Anne's-on-the-Sea. In one instance I was fortunate enough to observe one of these rain-made hollows formed. It occupied the centre of a deep crateriform sand Dune. It was forty-eight inches in diameter, and twenty inches deep in the middle. The centre of the hollow had reached the quicksand which underlies the base of the sand-hill.

Cwms.

May not the similar action of rain, during a lengthened period of time, account for the origin of Cwms. For instance, the beautiful Cwm which forms the N.W. front of Cader Idris, in the hollow of which lies Llyn-y-Gader. Through the moraine matter which stretches across the Cwm, I have heard, beneath the surface, the noise of the surplus water of Llyn-y-Gader rushing away. Rain is, I think, the Cwm maker, as well as the crateriformed Dune maker, and both are the effects of subaërial denudation and subterranean erosion acting in unison.

A Sequel.

On October the 5th, 1893, I received a letter from Professor G. A. Lebour, M.A., F.G.S., in which he stated as follows:—"I have only just had the opportunity of reading your very interesting note in the *Geological Magazine*, on Cwms formed by subterranean erosion, and hasten to send you a little paper which singularly fits in with some of your views." With the letter was inclosed the reprint of a paper by PROFESSOR LEBOUR, from *The Natural History Transactions of Northumberland, Durham, and Newcastle-upon-Tyne*, vol. xi., part 2, on "Certain Surface-Features of the Glacial Deposits of the Tyne Valley." He writes: "I have been led of late to pay special attention to the variable, but by no means small, outflow of water, which, by means of these many springs, takes place from the land to the river (Tyne.) Considering the incoherent character of much of the (glacial) deposits, and the steepness of the bluffs, it is not easy to note with accuracy how much sediment *from within the hill* is carried away by the springs, or to distinguish such sediment from the exactly similar material which is merely washed down after the issue of the water. By repeated observation, however, both during drought and after heavy rains, and at different seasons of the year, I have satisfied myself that a very notable amount of sand and very fine gravel, is continually being discharged at very varying rates from underground In other words, it is clear that the sands and gravels are being actively removed from within, as well as denuded from without."

It will be at once evident that PROFESSOR LEBOUR'S independent observations fully confirm my theory of the "Subterranean Erosion" of the Glacial Drift. PROFESSOR LEBOUR adds, that "It seems undeniable that underground erosion, acting in the manner indicated, is quite capable of producing hollows in the superficial deposits having all the characters of 'Kettle-holes.'"

"True Kettle-holes," he continues, "are held by glacialists to be highly characteristic of kames, and of terminal moraines. They are regarded as original surface-features left when the ice under which they were moulded last melted.

"That the bowl-shaped depressions of the surface of the Sand and Gravel Drift of the Tyne Valley, as exhibited near Corbridge, are now in process of constant formation and destruction, and that they therefore cannot be in any way attributed to ice action—this, I think, is sufficiently proven. The point is not unimportant, since on it hinges to some extent the question of the amount of denudation which has taken place since glacial times, and the date of the last great ice-age. I cannot regard any part of the present surface-contour of the drift that so largely fills our larger Northumbrian valleys, as original—*i.e.*, as practically unchanged in form since the disappearance of the glaciers.

"Incidentally, I think a second point has been established, viz., that an anticlinal or arched-bedding in drift sands and gravels, such as is often stated to be typical of kames and eskers, may also be caused by slipping, due to the eroding action of water below ground."

In a postscript PROFESSOR LEBOUR remarks, that "Subterranean erosion has recently been treated in several papers, and the subject, if followed up, seems likely to yield valuable results. I would especially refer to a paper by MR. W. SHONE, in the *Quarterly Journal of the Geological Society*, vol. xlviii., 1892, p. 96; and to another by MR. H. B. WOODWARD, in *Natural Science*, vol. ii., 1893, p. 124." I must return PROFESSOR LEBOUR'S reference to my paper upon this matter, by stating that his more recent contribution is most valuable, and should be carefully studied by all interested in the effects of "Subterranean Erosion."

In my opinion, this much neglected "principle of geology," when carefully studied, will be capable of solving many, at present, inexplicable problems connected with sedimentary strata *before* such deposits were consolidated into *rock*. I say this advisedly, and after much thoughtful consideration of the possibilities of a clearer and better interpretation – shall I say truer, for all human knowledge of truth is but relative—of the text of the "Record of the *Stratified* Rocks."

A NOTE OF THE SUBMERGED FOREST AT RHYL.

A FEW notes upon the exposure at Rhyl, about three-quarters of a mile east of Rhyl Pier, in February, 1893, of the remains of a Submerged Forest on the shore, ten feet below high-water mark, should perhaps be recorded. The *Liverpool Echo*, of February 7th, 1893, contained the announcement of a—

REMARKABLE DISCOVERY AT RHYL: A SUBMERGED FOREST.—The action of the tide at Rhyl, within the past few days, has disclosed the singular sight of the remains of an ancient forest, which for the period of eighty years has been completely covered by the sea. The scoured portion of the beach where this remarkable sight is presented, is situated opposite the Marine Drive, about a mile east of the Pier. The Town Surveyor, Mr. R. Hughes, has made an accurate plan of the place, which shows about thirty trees rooted as they grew, whilst there are a number of horizontal trunks which appear to rest where they fell. Several of the trees have been proved to be of oak and elm, and the remainder appear to be birch, alder, and hazel. The stumps vary in diameter from twelve to twenty-four inches, and are situated about 100 yards from the edge of the sandhills, and are covered during high spring tides by about ten feet of water. The scoured portions of the sands which expose these old roots extend for about 550 yards in length, east, and vary in width from seven to thirty-five yards towards low water. Folk-lore asserts that this is part of an old forest, the portion in question being known as "Coed Brawr-y-Rhyl."

The fact of a tradition of a forest once existing at this spot is most important. It is very suggestive that the forestal remains are not of any great antiquity, and the cause which brought them down ten feet below high-water mark, has done so, in a geological sense, recently and swiftly.

The succession of beds that fill up the Vale of Clwyd in the neighbourhood of Rhyl, are as follows:—

No. 1.	Blown Sand	Post-Glacial
,, 2.	Alluvium	,,
,, 3.	Peat and Forest-Bed	,,
,, 4.	Blue Clay, *Scrobicularia* ..	,,
,, 5.	Boulder Clay	Glacial
,, 6.	Sand and Gravel	,,

Nos. 1, 2, 3, 4 are post-Glacial, and 5, 6 Glacial deposits. The beds of Sand and Gravel (No. 6), are the principal channels by which the underground water escapes. It will at once be observed that, in descending order, they underlie the Boulder Clay (No. 5), and the Blue Clay (No. 4), upon which rests the submerged Peat and Forest-beds (No. 3.) Any subterranean erosion of the Sand and Gravel (No. 6), must result in the subsidence of all deposits resting upon them, so long as such underground waste may have continued.

Unfortunately, the exposure of the Submerged Forest at Rhyl was of so few days that no opportunity of a thorough and exhaustive examination of the position and the causes of its occurrence was possible

Mr. J. D. Siddall, of Chester, was kind enough to examine the Peat (No. 3), and found it to be composed of the Common Reed (*Arundo phragmites*), "which is very characteristic of wet places." The remains of the Reed were in a very perfect state of preservation. The Blue Clay beneath the Peat and Forest-bed contained the common Esturine Marsh Shellfish, *Scrobicularia piperata*, erect in the clay, with both valves united as in life.

The peat was not continuous over the whole exposure, and patches of the Boulder Clay or Blue Clay came here and there to the surface. From this we may be sure that the forestal remains have previously been much exposed to the ravages of the encroaching sea, and that agrees with the account in the *Liverpool Echo*, which mentions that these forestal remains had not been seen "for the period of eighty years."

The summary of the evidence would appear to indicate that the Blue Clay is the site of an old marsh; that a forest for a time succeeded to the marsh, until an interruption in the drainage under-ground being removed, subterranean erosion again caused the then surface to sink and become a swampy wet place, and the fitting habitat of *Arundo phragmites*. The trees had apparently broken off about two feet above the roots, which was most probably the water level of the swamp. They were believed to be of oak, elm, birch, alder, and hazel. One trunk of a tree lay prostrate as though uprooted by a storm; the roots faced towards the N.W., the present direction from whence devastating storms most frequently occur along this coast. The peat in some parts was from eight to ten inches thick, but generally from four to six inches thick. The wood of the tree stumps was on the outside so soft that the blade of an ordinary pocket knife could be easily thrust into it; the inner wood, however, was of a dark brown colour, and extremely hard.

So far as it is possible to form an opinion, I should think the Submerged Forest at Rhyl was contemporary with the Submerged Forests of the shores of Lancashire and Cheshire. If any historical data could be found of this forest it would be of great scientific interest; I fear, however, it flourished in the Prehistoric Period.

That the Submerged Forests along the coasts of North Wales belong to a period beyond that of "authentic records," would appear from PENNANT'S Notes in his *Tours in Wales*, vol. ii., pp. 113-14.

"Pass over Gronant Moor. There is a tradition, that its extent was so great, that the people on this side could hold conversation over the channel with those of Cheshire. This may be exaggerated; but from authentic records, it appears, that this flat was formerly very extensive, and that it had been reduced to its present scanty limits by the fury of the sea, which still possesses its antient place. Previous to that catastrophe it was possessed by the See of St. Asaph, by virtue of a grant made by Edward the Black Prince, son of Edward III., to Llewelyn ap Madoc, elected Bishop of St. Asaph in 1357. The inundation happened in the reign of Henry V. Previous to that time the Bishop paid annually into the exchequer at Chester, as an acknowledgment, the sum of twenty marks; but Henry V., in 1414, and Henry VI., in 1445 and 1451, in consideration of the misfortune, released the See from that rent. If this record did not remain an incontestable proof of the ravages of the ocean on this part of the country, there exists other natural ones that would have given reasonable ground of suspicion. The Hyle sands, which run for twelve or fourteen miles parallel to the Hundred of Wirral, in Cheshire, and are divided from Wales by a narrow channel, were once, in all probability, part of the firm land of England. A few miles to the west of Gronant Moor, under the parish of Abergeleu, in Denbighshire, are to be seen at low water (1810), very remote from the shore, bedded in sand, immense numbers of oak trees; a forest before this event. Lastly, in the churchyard wall of Abergeleu is a dateless epitaph, in Welsh, signifying that a person who was interred there lived three miles to the north of that spot, a tract now entirely possessed by the sea."

PENNANT again in vol. iii., p. 156, refers to the remains of a Submerged Forest on the shore at Abergele: "I have observed, at low water, far from the clayey banks, a long tract of hard loam filled with the bodies of oak trees, tolerably entire; but so soft as to be cut with a knife as easily as wax. The wood is collected by the poorer people, and, after being brought to dry upon the beach, is carried home and used as fuel; but in burning emits a bad smell."

PROF. T. McKENNY HUGHES, M.A., F.R.S., in a paper published in the *Quarterly Journal* of the Geological Society, vol. xliii., pp. 98, 99, on the "Drifts of the Vale of Clwyd," states—"We have no data for determining the absolute age of the alluvial deposits in the upper part of the Vale. I have a very fine partly ground neolithic implement, picked up by MR. STUART MENTEITH in the gravel of the Elwy above St. Asaph, and given to me; but there is no evidence as to whether this was carried on to the gravelly bed of the river from the alluvial gravel which there spread across the valley from side to side, or was dropped in from the surface-soil. The North Wales fenlands of Morfa Rhuddlan were formed where the river spread over the low flat lands; its velocity was checked, and the transport of gravel ceased. So below St. Asaph, near Rhuddlan and Rhyl, for instance, the gravel banks give way to tidal silt, to which we will refer as the Morfa Rhuddlan beds, and which is probably newer still than some, at any rate, of the gravel near St. Asaph. The course of the river has altered considerably since the water-towers of Rhuddlan Castle were built.

"Sections through the silt have been sunk for various purposes here and there. For instance, I was informed that when the railway was being made along the coast, they dug out the blue estuarine clay to a depth of 18 feet to make the embankment, and near the bottom of the excavation found the skull of *Bos longifrons*, and the antlers of *Cervus elaphus*, which are now preserved in the Cambrian inn at Pensarn. These remains occur here and there all through the deposit. The *Balani* on the points of another pair of antlers show that it had projected above the surface of the clay for some time.

"On the south of Rhyl a trench cut out for draining-purposes exposed the following section:—

	ft.	in.
a. Surface-soil with broken shells of *Buccinum undatum* at the base, perhaps artificially carried there		
b. Blue clay, weathering brown in the upper part, containing shells of *Scrobicularia piperata*, with valves adherent	1	0
c. Peaty silt, no timber	0	6
d. Peat, with trees 15 ft. in length and 1 ft. 6 in. in diameter	2	0
e. Blue clay	3	0

"On the Morfa Rhuddlan beds rest the sand-dunes and the shingle which form a great natural bulwark against the sea, which is driven fiercely on this coast by the north-west winds. These Eolian beds are of any recent age down to the present day; there is no evidence of any of them being of greater antiquity than the Morfa Rhuddlan beds; yet it is probable that they were always represented along this shore, and played their part in aiding or checking the changes which submergences or elevation from time to time tended to produce."

The rapid inroads of the sea, whether on the drift-covered coasts of the eastern or western shores of England, proclaim the same story. The destruction of land has been so great within the limits of historic times as to be a matter of serious national importance. It is not the fury of an occasional storm we have, however, most to fear, it is rather the insidious "underground waste of the land," which is the main cause of the so-called "encroachments of the sea"

The Spring and Summer of 1893 at Colwyn Bay.

BY ALFRED O. WALKER, F.L.S.

THE weather during the six months, beginning with March of this year, has been so remarkable, that it would be unfortunate if the number of the *Proceedings of the Chester Society of Natural Science*, now in the press, were to appear without some notice of it.

After a January, of which the first half was cold, with a good deal of snow, and a February which, though wet, was not so to anything like the same extent as in the south of England, a period of drought set in. The total rainfall for each month will be seen from the annexed table, but the Society's District was fortunate in having the drought mitigated by rain, which occurred at the following periods at Colwyn Bay:—

April 16th and 17th	.. ..	0·49 inches.
April 30th to May 2nd	.. ..	0·38 ,,
May 14th to 20th	.. .. ..	1·11 ,,
June 22nd to 28th	.. .. ..	1·15 ,,
July 8th to 12th	.. .. ..	2·46 ,,

From the last date the drought may be considered as ended in this district.

As regards temperature, the only periods in which it exceeded 80° were:—

June 15th	=	81·0°
July 6th and 7th	=	81·5 and 81·7° respectively
August 8th and 9th	=	81.4 and 83·0 do.
August 15th	=	81·1

The temperature of the earth one foot below the surface, taken by a Negretté & Zambra slow-acting thermometer, having the bulb encased in paraffin and contained in a copper cylinder, were as follows:—

January 2nd	= 34°·8	June 2nd	= 58°·0
„ 17th	= 35·1	„ 15th	= 65·0
February 2nd	= 42·5	July 1st	= 63·0
„ 15th	= 42·0	„ 15th	= 61·3
March 1st	= 39·0	August 2nd	= 63·4
„ 17th	= 44·0	„ 17th	= 68·3
April 1st	= 50·0	September 1st	= 62·0
„ 17th	= 50·2	„ 15th	= 60·2
May 2nd	= 53·5		
„ 22nd	= 55·8		

It is clear from the above figures, when compared with the periods of rainfall and temperature, that the former of these agents has the principal effect in determining the temperature of the earth. Only 0·16 inch rain fell between August 6th and 18th, which comprised also the hottest period of the summer. The loosening of the earth, however, in digging up the thermometer, makes it easier for the rain to penetrate, and thus detracts from the value of the observations as a true indication of the underground temperature. The highest underground (one foot) temperature recorded in 1892, was 62° on July 4th; and in 1891, 59° on August 1st, but in this year observations were only made once a month.

Sea temperature was unfortunately seldom taken. On April 5th it was 46°; May 13th, 55°; July 22nd, 62°; Sept. 12th, 60°. In all cases these were taken at the bottom, from 5 feet to 12 feet below surface.

Crops.—The crops of Wheat, Barley, and Oats have been very fair, and in some cases very good as regards grain, but the Straw, as might be expected, has been generally rather short. Swedes and Turnips have done much better than could have been expected, the crops being as a rule fair, especially when sown rather late in June. The early-sown Swedes suffered much from mildew. The Potato crop has been good. Unfortunately the most important crop of all—that of Hay—was very poor; a serious matter in a pastoral district like ours.

On the other hand, the crops of fruit were extraordinarily abundant, more especially of all kinds of stone fruit. In an experience of twenty-five years I have never seen anything approaching the quantities of Plums, Apricots, and Peaches. Cherries were also abundant, but not more so than last year. There were also excellent crops of Strawberries, Currants, and Gooseberries, but the last suffered much from the attacks of Red Spider and the larva of the Currant Moth (*Abraxas grossularia.*) With regard to Pears and Apples in my own garden, the combined effects of a cold wet summer in 1892, and the present unusually warm and dry spring and summer, were very interesting. With the exception of Lord Suffield Apple, which bore well in all situations, it may be stated broadly that I had good crops of both Apples and Pears on trees that stood on a steep slope (and especially on espaliers), while where the trees stood on level terraces the crops were poor or none. Probably this may be accounted for by more moisture finding its way to the roots in the latter case than in the former, with the result that the wood in 1892 would be better ripened in the former.* Pears also ripened very unequally, and kept very badly, Gansel's Bergamot, Louise Bonne of Jersey, Marie Louise, and Thompson's, all gathered at the end of August and beginning of September, being mostly rotten before the end of the latter month, while fruit left on the same trees was still hanging at the beginning of October. Ribston Pippins were gathered quite ripe on August 30th, which were last year gathered on October 1st; while on the other hand a heavy crop of Glou Morceau Pears, on a S.E. wall, were not ready to gather on October 10th.

Phenological Notes for 1893, at Colwyn Bay.

Feb. 8.—Chaffinch singing.

" 19.—*Scilla bifolia*, *Chionodoxa Luciliæ*, *Narcissus*, *pallidus procox*, and Violets in flower—the first has been in bloom some days.

Mar. 26.—Plum on S.W. wall, and one bush in full blossom. Pears on same wall partly out.

" 30.—Hedge banks bright with *Ranunculus ficaria* and *Viola canina*; some Pear and Plum trees in full bloom; a few Lilac flowers open.

Apr. 2.—Blackthorn in full bloom; Birch, Sycamore, Horse Chestnut, and Poplar covered with half developed buds.

" 8.—Yellow Banksian Rose on S.E. wall has several flowers open; Horse Chestnut beginning to open flowers. Gansel's Bergamot Pear and Apricots on S.W. wall have rather large fruit set; Birch, Larch, Horse Chestnut, and Sycamores quite green.

" 19.—Late Tulips (*Azalea mollis*), and some late flowering Rhododendrons and Lilacs in bloom. Blackcap heard. Queen Wasps very abundant, but not on Cotoneaster.

" 21.—Maximum in shade 78°·2; at 9-30 p.m. 64°.

* For details of crops, comparative temperatures, &c., see *Gardeners' Chronicle*, July 29th, 1893, p. 120.

Apr. 23.—First Gooseberry Tart—fruit quite large! Saw two Chimney Swallows flying as if tired—these probably belong to the main flight, usually reaching this part about May 1st. Oaks now quite green; Ashes in flower, and showing a few leaves; but Beeches have scarcely opened a leaf bud. All Apple trees are in full bloom; Pears, Plums, and Apricots have their fruit set.

May 3.—Heard Turtle Dove and Corncrake.

" 18.—Hybrid Perpetual Roses in flower; Tea Roses on walls nearly done; Dog Roses (*R. Canina*) and Honeysuckle in flower in many places.

" 20.—Had a good dish of Peas.

" 21.—A few "Laxton's Noble" Strawberries.

" 22.—Had a dish of Early Potatoes from the field.

June 10.—Began Hay Harvest.

" 11.—Helianthus multiflorus fl. pl. beginning to flower, while "Spanish Iris" (*Xephron vulgare*) is still in bloom, and "English Iris" (*X. latifolium*) is only now in flower; some not yet open.

" 12.—Blackbirds have ceased singing for some time, while Thrushes and Cuckoos are seldom heard. The two former were still singing in St. James' Park and Kensington Gardens, London, at the beginning of July.

	First heard in 1893.	Earliest previously noted since 1871.
Chiff-chaff ..	March 16th ..	March 19th in 1881 & 1892
Willow Wren	April 6th ..	April 10th in 1883 & 1884
Swallows ..	April 23rd ..	April 13th in 1878
Corn-crake ..	May 3rd ..	April 28th in 1879
Cuckoo	April 20th ..	April 26th in 1885 & 1886

Aug. 9.—I finished harvesting Barley.

Temperature and Rainfall, Nant-y-Glyn, Colwyn Bay.

	January.		February.		March.		April.		May.		June.		July.		August.		September.	
	1893.	Aver.	1893.	Aver.	1893.	Aver.	1893.	Aver.	1893.	Aver.	1893.	Aver.	1893.	Aver.	1893.	Aver.	1893.	Aver.
Mean Maximum	42·6°	44·4°	46·7°	45·8°	54·7°	47·7°	60·7°	52·3°	63·7°	58·7°	69·2°	64·6°	69·1°	66·0°	70·7°	65·6°	62·7°	62·6°
,, Minimum -	35·0	35·6	37·9	36·0	40·0	35·5	42·0	38·3	48·3	43·3	50·5	48·9	54·0	51·2	55·2	51·2	49·4	48·4
Highest Shade -	53·2	—	58·1	—	67·0	—	78·1	—	73·2	—	81·0	—	81·8	—	83·1	—	70·5	—
Lowest ,, -	21·8	—	29·6	—	31·5	—	30·0	—	39·8	—	42·6	—	47·6	—	43·5	—	39·2	—
Rainfall - -	in. 1·91	in. 2·58	in. 2·40	in. 1·92	in. 0·36	in. 1·95	in. 0·62	in. 1·75	in. 1·38	in. 2·28	in. 1·28	in. 2·14	in. 2·98	in. 2·43	in. 1·74	in. 3·44	in. 3·66	in. 2·64
No. of days ·01 or more fell	18	—	15	—	6	—	3	—	11	—	9	—	11	—	12	—	21	—
Underground Temperature, 1st	34·8°	1892. 41·4°	42·5°	1892. 43·5°	39·0°	1892. 39·2°	50·0°	1892. 39·5°	53·5°	1892. —	58·0°	1892. 58·0°	63·0°	1892. 62·0°	63·4°	1892. 60·8°	62·0°	1892. 58·2°
,, 15th	35·1	—	42·0	—	44·0	—	50·2	—	55·8	57·8	65·0	59·0	61·3	57·8	68·3	60·3	60·2	55·0
Sea Temperature	—	22nd. 38°	—	—	—	—	5th. 46°	—	13th. 55°	—	—	—	22nd. 62°	—	—	—	Oct. 5. 54°	—

The average Mean Maximum and Mean Minimum are for thirteen years (1880 to 1892), except the Mean Minimum of April, June, July, and August, which are for twelve; and September, which is for eleven years. The average Rainfall is for twelve years (1881 to 1892.) The Underground Temperature was taken from a slow-acting thermometer, buried one foot below the surface, and dug up on the dates given. The Sea Temperature was taken at the bottom, in from five feet to twelve feet of water, except the last (October 1893), which was taken on the surface.

The Weather at Chester during the first ten months of 1893.

BY REV. J. C. MITCHELL, B.D., F.R.A.S.

THE weather during this period was remarkable, perhaps even unprecedented—as it has been in some parts of the South and East of England; but the want of any reliable observations here covering a sufficient length of time renders comparison impossible, and makes this doubtful. It is certainly one of the most noteworthy seasons which the memory of the "oldest inhabitant" can recall.

TABLE I.—ATMOSPHERIC PRESSURE.

1893.	Mean Pressure at 32° and Sea Level. 9 a.m.	Difference from Bidston. Average 8 a.m.	9 p.m.	Observed Monthly range.
January	30·053	+·129	30·079	1·124
February	29·547	—·387	29·652	1·599
March	30·096	+·185	30·224	1·092
April	30·201	+·334	30·238	·638
May	30·064	+·103	30·082	·973
June	30·139	+·173	30·165	1·084
July	29 888	—·018	29·888	·762
August	29·998	+·092	30·129	·893
September	29·847	—·088	29·827	1·190
October	29·858	—·021	29·864	1·435

With the exception of February, the monthly range is low, indicating great steadiness, the result of the anti-cyclonic conditions so long prevalent, which gave their character to the whole season. This, also, accounts for the pressure being half an inch above the average, giving a weight of atmosphere greater than is usual at sea level.

TABLE II.—TEMPERATURES.

1893.	Mean Temperature of Max.&Min.	Difference from Average.	Mean Daily Range.	Difference from Average.	Extreme Monthly Range.	Number of Night's Frost. In Shade.	On Ground.
January	36·5	—1·7	11·3	+1·4	42·9	11	23
February....	40·7	+0·1	9·8	—1·2	30·5	3	11
March	47·4	+6·3	18·5	+5·0	36·7	3	18
April	51·4	+5·0	22·8	+6·7	45·6	2	9
May........	54·8	+2·8	18·1	+0·3	37·9	0	2
June	61·5	+3·6	20·1	+2·2	43·7	0	0
July........	63·0	+2·2	14·8	—1·8	36·4	0	0
August	64·7	+4·9	15·8	—1·2	44·1	0	0
September ..	56·8	+1·1	15·9	—0·2	38·8	0	0
October	52·3	+3·7	14·5	+1·9	42·0	1	2

The most marked feature in the season's weather is the unusually high temperature, setting aside the two first months, January and February, which were, in most respects, of such a normal character as hardly to enter into consideration in this connection. March was nearly 6·5° F. above the average for that month; indeed it was almost 1·5° F. hotter than an ordinary April. At the other end of this remarkable period, October had only a few degrees short of a September mildness. All the intervening months were also much above the average. Spring and autumn being thus favoured with such high temperatures, had the effect of lengthening out summer at both ends, and making it the warmest and sunniest ever known.

ITS EFFECT ON VEGETATION

May perhaps be better understood by remembering that during these eight months the shade temperature only fell below the freezing point *six* times. May blossom was seen on several hedgerows here in the third week of April. On the 1st day of November a second crop of raspberries were ripe. The new canes were blossoming, and Pansies, Fuschias, Stocks, Marigolds, Geraniums, Jessamin, Dahlias, &c., were in full flower. In such plants as the *Berberis Darwinii*, there has not only been a second flowering, but the fruits of the second flowers have developed. A second crop of Broad Beans have been gathered; and upon some of the fruit trees there was a second lot of blossom, and in some instances a second crop of fruit, swollen to perhaps one-fifth normal size. Second crop Strawberries, fully-ripened, have been common. Such flowering shrubs as *Weigelias* and *Lonicera* have bloomed a second time. Many Conifers, after having formed their winter buds, started into a second growth, and have formed a second bud.

TABLE III.—RAINFALL.

1893.	Total Rainfall.	Difference from Average.	Number of Rainy Days.	Difference from Average.	Greatest fall in one day.
January	1·275	—1·125	16	—0·1	·225
February	2·975	+1·405	22	+8·3	·50
March	·925	— ·795	7	—6·5	·35
April	·645	— ·845	5	—8·9	·45
May	1·390	— ·750	13	—1·2	·34
June	1·565	—1·055	10	—2·8	·63
July	2·626	— ·234	19	+2·3	·465
August	2·855	+ ·245	15	—0·4	·62
September	1·900	— ·740	18	+2·8	·32
October	1·870	—1·250	19	+1·4	·475

Confining our attention to the last eight months of our period, it will be seen that the rainfall in August was equal to the average—indeed exceeded it by a quarter of an inch—while in all the others it fell very considerably short, by about 4·5 inches. The number of days on which it rained is also under the usual figures. The effect of this on vegetation and village water supply is serious. This may be realized if we consider that it means a deficiency of 450 tons of rain-water to every imperial acre, and that in the face of greater heat and brighter sunshine and clearer skies, which produces greatly increased evaporation. Besides, a good deal of this rain fell in heavy showers, and was speedily drained away, neither benefiting vegetation nor the wells to the same extent as if it had come down in quieter showers, extending over a longer time. (Up to the present time, the middle of December, only 20·5 inches have fallen this year.)

TABLE IV.—RELATIVE HUMIDITY OF AIR, AND AMOUNT OF CLOUD.

1893.	Mean relative Humidity of the Air.		Difference at 9 a.m. from the Average.	Mean amount of Cloud.		Number of days	
	9 a.m.	9 p.m.		9 a.m.	9 p.m.	Cloudless.	Overcast.
January	92	92	+4	7·7	6·9	1	11
February	84	81	—2	8·1	6·8	0	15
March	71	82	—9	5·0	3·3	11	7
April	75	87	+1	4·0	3·0	10	13
May	75	89	+6	6·5	5·6	2	11
June	68	81	—1	6·0	6·0	4	25
July	79	91	+7	8·0	6·5	0	11
August	66	84	—9	6·1	5·5	0	7
September	88	94	+7	7·8	5·4	1	11
October	75	88	—8	6·8	6·1	1	7

The air has frequently been very dry, often during the early hours of the afternoon, only one-fifth of the amount of perfect saturation being registered; a degree of dryness not often felt in ordinary seasons.

Cloud.

"Cloudy Chester" has this year experienced such clear skies, and consequently bright sunshine and magnificent starlit nights, as cannot be remembered. March and April being especially distinguished; the former having eleven, and the latter ten days cloudless at 9 a.m.

Table V.—DIRECTION AND VELOCITY OF THE WIND.

From observations at 9 a.m. and 9 p.m. daily.

1893.	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	Calm.	Force. Mean.	Force. Maximum.
January	5	1	0	2	1	3	5	7	38	1·42	6
February	4	1	3	2	18	11	7	6	10	2·2	8
March	3	0	0	0	3	2	2	10	42	2·5	5
April	0	0	1	1	1	0	0	4	53	0·54	6
May	1	1	1	1	6	2	4	4	42	1·5	5
June	5	0	7	4	2	4	0	8	30	2·1	8
July	1	0	0	2	9	6	2	18	24	2·1	6
August	4	0	1	0	9	5	13	4	26	2·1	7
September	1	0	0	0	0	7	7	10	35	1·2	6
October	1	0	0	0	1	4	7	9	40	1·1	4

To add to the enjoyableness of this fine season, the winds were very light and pleasant, blowing almost exclusively from south, round by west to north, tempering the heat. The highest winds, which took place in June and August, did not rise to the force of a gale.

The weather of this most remarkable period may be summed up as calm, clear, dry, warm, and bright.

Zoological Observations during the Spring and Summer of 1893.

BY R. NEWSTEAD, F.E.S.,
CURATOR OF THE GROSVENOR MUSEUM, CHESTER.

AS the past season has been such a remarkable one, it has been thought advisable to place on record notes of special interest relating to birds and insects. The observations on the birds have, without exception, been made during my daily walk to and from the City and Saltney. I am unable to say how these notes compare with former years; as, although I have always taken a keen interest in the arrival of our feathered friends, systematic notes have not been kept. It will, however, be interesting to compare them with Mr. A. O. Walker's [*Ante* p. 170], as observed at Colwyn Bay. As regards the insects, it will be seen that the field of observation covers a wider area.

BIRDS.

The following were first heard singing on the dates given below:—

Jan. 20.—**Blue Tit.**

„ 27.—**Skylark,** and at intervals during the month.

„ 30.—**Redbreast.**

„ 30.—**Marsh Tit,** and often during February and March. I think these birds must nest either in or near Curzon Park. Their call-note or song much resembles that of the Chiff-chaff.

Feb. 2.—**Hedge Sparrow,** and at intervals during the month.

„ 8.—**Song Thrush.** On the 10th many were singing at 7 a.m., during a heavy gale of wind.

„ 16.—**Lesser Redpoll.** Undoubtedly a stray specimen, as I have not hitherto seen the species near the city.

„ 22.—**Great Tit.** Very appropriately called the "Saw Sharper" in Norfolk.

Mar. 7.—**Chaffinch.**

„ 17.—**Yellow Bunting.**

„ 24.—**Chiff-Chaff.**

„ 25.—**Gold Crested Wren.**

„ 25.—**Common Wren.**

Apr. 18.—**Willow Wren.** The American Zoologists consider this the best British Song Bird.

„ 18.—**Swallow** first seen*.

* My Father saw the Swallow, at Ince, about the 2nd of April.

INSECTS.

Scale Insects (*Coccidæ.*) I have two notes of special interest in connection with these insects. According to previous observations the males of all the British species do not appear before the end of April or the beginning of May. This year, however, the males of a species of *Pseudococcus*, which lives on the trunks of various Laburnums along Hough Green, were out in numbers on the beautiful warm day of March 22nd.

The second record is of still greater interest and economic importance. The thorn fence which divides the Roodee from the Grosvenor Road, for several years has been infested with one of the large brown "scales" (*Lecanium genevense*), and has always occurred in considerable numbers; but this year they increased to such an enormous extent that they almost covered the branches from one end of the fence to the other, and although many have been destroyed by accident, yet at the time of writing this, they may still be found in sufficient numbers to warrant this statement. The season has undoubtedly proved favourable to their development, and if they continue in such vast numbers, the fence ere long will succumb to their ravages. A single female of this species lays over 2,000 eggs; fortunately only one batch are laid in a season, and the young brood for the coming year may now be found as small brown specks on the bark, amongst the old dead bodies (scales) of the females. This species, like many others, secrete a quantity of honeydew, and during the past summer the leaves on the fence in question were completely blackened with it.

The Onion Fly (*Anthomya ceparum*, Bou.) Many specimens of this serious pest made their first appearance in my breeding cages on April 27th. That this note may be of service to economic entomologists, I may say that the pupæ were kept out of doors in a cool shady place, so that the appearance of the flies was not at all premature. Undoubtedly those in a state of nature hatched at the same time, and it would be interesting to know if this early occurrence of the flies in any way lessened the attack on the "spring sown" onion crop. So far as my own experience goes the latter were not so badly infested at Ince as in previous years. I venture to think that many of the flies died long before the plants were sufficiently large to support their ravenous larvæ

Celery Fly, *Acidia heraclei, L.* (*Tephritis onipordinis*, Fab.) Swarms of this pretty but destructive little miner made their appearance at the same time and under the same conditions as the above. This must be a very early record, and unless the flies had other plants on which to rear their larvæ, they must have perished long before the celery plants were planted where they could attack them. I have bred numbers of the small Hymenopterous parasite (*Adelura apii*, Curtis), from this pest, which I believe has not hitherto been recorded as infesting it.

Abundance of **Ladybird Beetles** (*Coccinellidæ.*) I never before saw these pretty and useful insects in such numbers as this year. At Ince, Chester, during August, the banks of the Mersey and the adjoining pasture land, extending from the "North Hills" to the Tang, were almost alive with the rather small but pretty *Hippodamia variegata*. In the early morning (6 a.m.) they were sitting motionless in crowds on almost every piece of tidal refuse, &c., that could be found, apparently enjoying the early rays of the morning sun. I tried to find out what these insects were feeding upon but failed. A large flock of Starlings daily visited this locality, and as they were continuously hunting amongst the grass I wondered if they were feeding on the "Ladybirds." Two victims, which fell to my gun to satisfy me on this point, were found to have been feeding chiefly on *Coleoptera*, but not a trace of a *Coccinella* was found in either.

The two large species *Mysia oblongo-guttata* and *Anatis ocellata*, which feed upon the Pine Aphis (*Chermes pini*, Koch), were exceedingly common upon the fir trees at Sandiway, Cheshire, where I could have obtained almost any number of them. Here my father and I spent several hours "beating," and our principal takes were *Coccinellidæ*. The Lepidopterous larvæ which always occur in the above locality during August, were absent; they had undoubtedly "fed up" and pupated; even the very commonest species were not seen

The Green Tortoise Beetle (*Cassida vindis*), has appeared in considerable numbers on the embankment of the Manchester Ship Canal, near Ince. It was first taken by Messrs. Tomlin and Hodges; subsequently my brother and I found them in great numbers in the same locality, feeding on the "Plant Lice" (*Aphis*), which infests the "Marsh Thistle." This beetle is by no means a common insect in our district, and it is curious that it should occur on the new embankment of the Canal. I spent many hours "beating" for the species on the adjoining marsh, but without success.

The Red Admiral Butterfly (*Vanessa Atalanta*), occurred in great numbers during the Autumn. In the marshy districts during August the *larvæ* and *pupæ* occurred in almost every patch of nettles. My father was telling me the other day how fond these insects are of over-ripe fruit, and that when once in possession of the latter they will guard it with great zeal; a single wasp proving no match for them. Their method of defence is to open out their gorgeous wings in quick succession, which has the desired effect on a single wasp, but not on three or four.

Birds of West Cheshire, Denbighshire, and Flintshire:

Being a List of Species occurring in the District of the Chester Society of Natural Science.

BY W. HENRY DOBIE, M.B, M.R.C.S.,

MEMBER OF THE BRITISH ORNITHOLOGISTS' UNION.

THE following list is an attempt to collect observations on the occurrence and distribution of birds in different parts of our district, in the hope that it may form a nucleus round which further observations will rapidly accumulate. As time and opportunity have been limited, the list is very incomplete, and it is only through the encouragement and assistance of MR. A. O. WALKER, and the hearty co-operation of MR. R. NEWSTEAD, that it appears at all. MR. WALKER, in addition to placing his own diary notes at my disposal, has most kindly written a short introduction on the physiography of the district. The value of MR. R. NEWSTEAD's contributions will be at once recognized: he, too, has spared no pains in helping me, by furnishing notes of birds in the Grosvenor Museum, procuring information from various sources, and revising my proofs.

BROCKHOLES' list of the Birds of Wirral, published twenty years ago as the first number of "Proceedings" of this Society, is now out of print and difficult to obtain; it is, therefore, incorporated with the present list, for the convenience of those who do not possess a copy, being quoted *verbatim*, under the description of each species.

I have endeavoured, in all cases, to acknowledge the source of my information; but often, for the sake of brevity, by giving only the initial letters of my authorities, whose full names will be found by referring to a page at the end of the list.

To all these, and others, whom I forbear to name for fear of omitting any, I must express my warmest thanks for their kindness in furnishing me with information, allowing me to inspect their collections, and otherwise interesting themselves in my undertaking. I am, however, specially indebted to PROFESSOR NEWTON, MR. HOWARD SAUNDERS, and MR. CORDEAUX, for their assistance; also to SIR PYERS MOSTYN (Talacre), THE HON. CHARLES WYNN (Rûg), and MR. CONGREVE (Burton Hall), for kind invitations to look over their valuable local

collections, and permission to publish notes of their specimens; also to MR. PADEN (Derby Museum, Liverpool), MR. MADELEY (Municipal Museum, Warrington), and MR. LINNÆUS GREENING, for their courtesy in facilitating my inspection of those collections, and giving me every information in their power. And I must make special acknowledgment of the valuable help of MR. T. RUDDY, who, residing for more than twenty years at the Gardens, Palé, in the Upper Valley of the Dee, and in the centre of an interesting hill district, has given almost as much study to birds as to fossils; and has not only furnished me with notes of his own, but others of the late MR. BECKWITH, of Shrewsbury, who extended his observations from Shropshire and Montgomeryshire, into the part of Denbighshire lying south of the Berwyns.

With regard to the district immediately surrounding Chester, I have received the help of MR. NEWSTEAD, my brothers, and of MR. SYDNEY CUMMINGS, whose accurate ear for the notes of birds, both young and old, and knowledge of their nesting habits, make him a most valuable observer.

PHYSIOGRAPHY OF CHESTER DISTRICT WITH REFERENCE TO BIRD-LIFE.

THE district adopted by the Chester Society of Natural Science, consists of so much of Cheshire as lies W. of a line drawn S. from Warrington, with the Counties of Flint and Denbigh. It will be seen, at once, that this comprises a great variety of country, both in regard to altitude, ranging from the coast up to 1850 ft. above the sea, and to the character of both land and water. It comprises one side of the Estuaries of the Mersey and Conway, and both sides of the Dee, all of them having large areas of sand and mud laid bare at low tide, and eminently adapted for the Wading and Swimming Birds. In Cheshire, there are ranges of hills of Triassic sandstone, covered on their summits in parts with forest and heath, as is especially the case in Delamere Forest. The low grounds are for the most part pasture, and few fields are without the old marl pits, now ponds full of aquatic plants, and the haunts of Moorhens, Dabchicks, and other Waterfowl. The two Welsh Counties, though not containing mountains equal to those of Carnarvonshire, yet form a land of hill and dale with large areas of elevated moorlands. Along the south-west side of the Estuary of the Dee, rises the Carboniferous range of hills, which forms a continuous outwork to the older formations extending from the mouth of the Vale of Clwyd to Llangollen. Behind these is the loftier Silurian range, forming the eastern boundary of the Vale of Clwyd; and on the western side of this is a vast area of confused hills and valleys, also of Silurian age, mostly moorland, and sparsely inhabited. These two ranges unite at the head of the Vale of Clwyd, and pass on southward to the furthest limits of Denbighshire, including in this area the beautiful Vales of Llangollen and the Ceiriog.

Nor is the climate much less varied than the physiography of the district. That of southern Cheshire is practically the climate of our Midland Counties generally; while that on the North Coast of Flintshire and Denbighshire more nearly approaches that of Devonshire in its equable character; that of Chester and the low parts of Flint and Denbigh being intermediate.

Why is it, that with all this variety of soil, altitude, and climate, with sea-coast, estuarial mud-flats, mountain moorland, and cultivated land, the district of the Chester Society has not a richer *avifauna*? A. O. W.

The number of species which I have been able to admit to my list, on what I regard as fairly good evidence of their having occurred in a genuine wild state, is about 220.

That the number is not greater is no doubt due in part to the incompleteness of the list—which I hope will soon require to be supplemented—but, in part, because our district happens not to lie in any of the great routes of migration. It can never compare as a "bird district" with our Eastern Counties, which receive the great autumnal bird-wave from across the North Sea; and even lies off the line of the West Coast movement of land birds, which are said to make their journey between the Mull of Galloway and Anglesey by way of the Isle of Man.

EXPLANATION OF LIST.

The District includes:—

(*a*) Cheshire, west of a line drawn southwards from Warrington;

(*b*) Denbighshire;

(*c*) Flintshire;

(*d*) A small portion of Carnarvonshire east of the mouth of the Conway, including the Great and Little Orme's Head;

(*e*) A slip of Merionethshire running down the course of the Dee, between two portions of Denbighshire, of which it seems naturally to form a part. Corwen is its centre, and it includes Palé and Rûg, to which reference is often made.

NOTE.—This last portion I have included on my own responsibility, as I have found it impossible to separate its records from those of the adjoining borders of Denbighshire.

The part referred to as "MR. RUDDY's district" has its centre at Palé, and extends to the Vale of Clwyd as far as Ruthin, and the district around Llangollen and Glyn Ceiriog, including the Berwyns and Llangwm hills north-west of Corwen.

The terms "Wales," "Welsh Coast," &c., refer to that part only which is included in "the District," unless the more extended meaning is obvious.

The arrangement and nomenclature of HOWARD SAUNDERS' *Manual of British Birds* has been followed throughout.

BROCKHOLES' list of the "Birds of Wirral" (published in 1874), is referred to for the sake of brevity as "Br.," followed by the page quoted.

Initial letters in brackets after a statement give the authority for it, and refer to the list at the end of the paper, where the full name will be found.

An alphabetical list of the places mentioned in the list is also given, each being referred to its County.

"Coll. G.M." means that the specimen is in the Society's Collection at the Grosvenor Museum, Chester.

An asterisk before the name of a species indicates that the Grosvenor Museum possesses at least one local specimen (the district for exhibitive purposes including the whole of Cheshire and North Wales.)

A double asterisk shews that a case has been, or is being prepared by MR. R. NEWSTEAD, illustrating its "Life History."

A bracket enclosing the name of a species indicates that it is not known to have been recorded in the district; or not considered to have occurred in a wild state. The evidence in most other doubtful cases has been given, and simply left to speak for itself.

BIRDS OF THE DISTRICT.

Order PASSERES.

* Turdus viscivorus. MISTLE-THRUSH.

A common resident. Much less common than in the Eastern Counties [R.N.] Not very common at Colwyn Bay [A.O.W.]; Combermere [Lord C.]; and Little Budworth [A.P.W.] Not so common as it used to be at Nant-y-ffrith [R.H.V.K.] Common at Palé. Very fond of Mountain Ash berries [T.R.]

"A common resident" in Wirral (Br. p. 5.)

* **Turdus musicus.** SONG-THRUSH.

"An abundant resident" in Wirral (Br. p. 5), and throughout the district. BROCKHOLES adds—"The nest is sometimes built on the ground in woods. I once knew one on the ground in the middle of a large field, at a considerable distance from any bush. I have known three instances of a nest in the cavity of an old Magpie's nest."

For note by Mr. A. O. WALKER on the scarcity of this species in 1880-81, (*ante* p. 204.)

In 1884 Messrs. WOEK & CLAGUE, who were then in charge of the Dee Light Vessel, noted an autumnal migratory movement of this species between October 21st and 23rd, and again on November 10th. Observations made on the sex of those killed proved that males and females migrated in company (*Report on Migration of Birds*, 1884, *p.* 112.)

* **Turdus iliacus.** REDWING.

A common winter visitor, often becoming very tame in hard weather. Frequent in the Leadworks Gardens, Chester [A.O.W.], where the specimens in the Grosvenor Museum were shot. MR. NEWSTEAD says they arrive here about the middle of November, and that in 1889 numbers of them remained in the Eaton Woods as late as April 15th. In the early mornings during March he often heard them singing in the fir trees near the Overleigh Lodge, and occasionally in the thorn bushes on the Dee Bridge embankment. He noted "the song is very feeble, comparatively speaking, and resembles that of the Lesser Redpoll" This is evidently not the summer song of the Redwing, as I have heard it in Norway.

"A common winter resident" in Wirral. (Br. p. 5.)

They were noted on migration at the Dee Light Vessel in 1885 between October 15th and 30th.

* **Turdus pilaris.** FIELDFARE.

A regular and common winter visitor.

BROCKHOLES notes it as "a common winter visitor" to Wirral; and adds, "Two or three years ago, a flock were constantly near the house. Two of these birds were frequently at an unfinished nest in a hedge; but all the flock departed before this was finished, and it never came to anything. Denhall. A few years previously, I saw a Fieldfare on an unfinished nest. The bird forsook on being disturbed. Maghull, Lancashire." (Br. p. 5.)

* **Turdus merula.** BLACKBIRD.

"An abundant resident" in Wirral (Br. p. 5) as in all the district. Far commoner than the Song-Thrush at Colwyn Bay, where it is becoming a serious pest to gardeners. [A.O.W.]

Mr. W. KERR (Maesmor) says—"they are a plague;" and Mr. RUDDY, that "unfortunately it is commoner than the Thrush, and devours fruits of all kinds."

MR. G. W. HAYES thinks that Thrushes are more common than Blackbirds at Ashton Hayes in the breeding season, and that in September the gardens are, in a great measure, left by both for the potato fields, &c.

MR. WOLLEY DOD says that at Edge Hall there are far too many of both Blackbirds and Thrushes in summer, but most of the latter disappear in November, leaving the Blackbirds much the more numerous through the winter.

** **Turdus torquatus.** RING-OUZEL.

A common summer visitor to the hilly parts of the district, where it breeds, *e.g*, Bickerton Hills [Eggs coll. W.H.D.], Overton and Helsby Hills [R.N.], Minera [R.N.], Moel Fammau [A.O.W.], the Berwyns [E.C.D.], Vale of Clwyd [W.H.H.]

Mr. RUDDY notes that it occurs from April to September, nests on ledges of rock or under tufts of heather, and is fond of Mountain Ash berries.

MR. A. O. WALKER saw one on Moel-y-gamelin on April 3rd, 1885.

Not noted at Combermere [Lord C.], or Colwyn Bay [A.O.W.]

In Wirral "an occasional visitor. In April, 1864, I found a nest containing four eggs at Puddington." (Br. p. 5.)

* **Saxicola œnanthe.** WHEATEAR.

An abundant summer visitor to the sea-coast and hilly parts of the district: occasionally seen on the Dee "Cop" [S. C.] and the Golf Links, Queen's Ferry [H.D.] Common all along the Mersey "Cop" from Stanlow to the Frodsham Marshes [R.N.] Breeds on the coast at Colwyn Bay [A.O.W., R.N.]

In Wirral "an abundant summer visitor." (Br. p. 6.)

* **Pratincola rubetra.** WHINCHAT.

A common summer visitor. Abundant on the Dee "Cop," where it breeds [S.C.] Common at Ince [R.N.] Wrexham [A.D.] Colwyn Bay [R.N.]

Appears to be commoner than the Stonechat in Cheshire, and in Mr. RUDDY's district, but rarer than that species along the Welsh Coast.

In Wirral "an abundant summer visitor." (Br. p. 6.)

** **Pratincola rubicola.** STONECHAT.

Common, bnt much more so in summer than winter. MR RUDDY notes, "very few during winter;" MR. DARBY

(Wrexham), "never seen in winter;" MR. VENABLES KYRKE, "a few couples generally to be seen on the hills in winter." Scarce in the marshy district of Ince, Stanlow, and Helsby [R.N.]

In Wirral: "abundant in summer in suitable localities. This is a partial migrant here, the majority leaving in autumn, whilst a few remain all winter." (Br. p. 6.)

Ruticilla phœnicurus. REDSTART.

A common summer visitor to our Welsh counties: *e.g.*, at Wrexham [A.D.], Chirk, Llangollen, Vale of Clwyd [W.H.H.]; but not very common on the hills at Nant-y-ffrith [R.H.V.K.] MR. RUDDY notes it as "common, arriving at the end of April." Occurs at Colwyn Bay, but is not common [A.O.W.]

It was formerly common in the City of Chester [A.O.W.], but is now rare in the neighbourhood. Occasionally nests at Delamere [R.N.], and every year at Edge Hall [C.W.D.]

BROCKHOLES notes it as "a scarce summer visitor. Eastham, Puddington;" and adds, "I once met with a female specimen during severe weather in winter on the Leasowe embankment." Was this not more probably the female Black Redstart (*Ruticilla titys*)?

* Ruticilla titys. BLACK REDSTART.

A male specimen was killed at Gorsedd, near Holywell, March 25th, 1889. [Coll. G. M.]

On May 7th, 1888, MR. R. NEWSTEAD saw a pair of these birds (male and female) in some old oak trees in the Eaton Park, Chester. He says "there is not the least doubt as to the identity of the species, as the birds, especially the male, gave me a good opportunity of seeing it several times as it flew from tree to tree."

** Erithacus rubecula. REDBREAST.

"An abundant resident" in Wirral (Br. p. 5) as everywhere else in the district.

Daulias luscinia. NIGHTINGALE.

Mr. C. WOLLEY DOD has published a record of its occurrence (*Field*, May 25th, 1889, p. 754.) The note he has kindly sent to me of it is as follows: "1889. In Lowcross Gorse, in the parish of Tilston, by Malpas, a quarter of a mile from Edge Hall, a Nightingale sang every night through May."

Mr. W. E. SHARP, Ledsham, writes: "The supposed occurrence of this bird in Birkenhead Park in 1863 gave rise to much controversy, and was never placed beyond a doubt. This ear, however (1893), the species has visited Ledsham, and was heard nightly by me all through May and part of June, who, being familiar with its note in Worcestershire, recognized it at once."

Mr. RUDDY writes: "I have no authentic account of a Nightingale in North Wales. I believe the Garden Warbler has been mistaken for it. We had an instance of this near Corwen this year (1893); but it would be in vain to try and convince the bulk of the people that it was not a Nightingale, or Eos, as they call it."

Sylvia cinerea. WHITETHROAT.

An abundant summer visitor.

Sylvia curruca. LESSER WHITETHROAT.

A summer visitor, not uncommon near Chester, but very local. In 1893 two pairs were found nesting in Sealand within a hundred yards of each other [S. C., H. D.] Occasionally seen at Delamere [R.N.] Occurs at Ince, but is rather scarce [R.N. Sen.]; the same may be said of Colwyn Bay [A.O.W.] Not observed by MR. RUDDY. Not very uncommon at Nant-y-ffrith [R.H.V.K.]

"Scarce in the north of Wirral. Common in some seasons at Denhall and Puddington. A summer visitor." (Br. p. 6.)

Sylvia atricapilla. BLACKCAP.

A summer visitor, very common in the neighbourhood of Chester and in North Wales; less so in the Delamere Forest district [R.N.] Breeds at Edge Hall [C.W.D.]

In Wirral, "an abundant summer visitor." (Br. p. 6.)

Sylvia hortensis. GARDEN WARBLER.

A summer visitor much less common than the Blackcap in most parts of the district, but in the neighbourhood of Ince, Mr. NEWSTEAD, SENR., thinks they occur in about equal numbers; and MR. R. H. V. KYRKE says the same of Nant-y-ffrith. Breeds every year at Edge Hall [C.W.D.]

BROCKHOLES says—"I have twice detected this species, the first time in May, 1860, at Prenton Mount, near Birkenhead; the second time in May, 1861, at Puddington, where I obtained a nest. R. BARTON, Esq., tells me it annually visits Caldy. It is a summer visitor." (Br. p. 6.)

** **Regulus cristatus.** GOLDEN-CRESTED WREN.

A common resident. At Chester is sometimes seen in gardens quite in the City. Breeds on the Eaton Estate, in Delamere Forest, at Colwyn Bay [A.O.W., R.N.], &c. In winter it is very common in Delamere Forest, and at Ince, where it frequents gardens and feeds extensively on the American blight (*Schizoneura lanigera*) [R.N.]; also in the fir woods of Storeton, Bebington, and Burton [W.E.S.]; at Llandyrnog [J.B.]; and in Mr. RUDDY'S district "wherever fir trees occur."

In Wirral, "a common resident in fir woods." (Br. p. 6.)

Phylloscopus rufus. CHIFFCHAFF.

"A common summer visitor" to Wirral. (Br. p. 6.)

Also throughout the district. It may be heard singing in September [A.O.W.]

* **Phylloscopus trochilus.** WILLOW-WREN.

"An abundant summer visitor" to Wirral (Br. p. 6), as also to the district generally.

Phylloscopus sibilatrix. WOOD-WREN.

"A common summer visitor" to Wirral (Br. p. 6.) Much less common in the district than the two previous species. Rare in MR. RUDDY'S district. Not very common at Ince [R.N.] Common in the woods at Colwyn Bay [A.O.W.]; and at Nant-y-ffrith [R.H.V.K.]

Acrocephalus streperus. REED-WARBLER.

Although not uncommon in the east of Cheshire, this species is very local in our district.

A nest was given me by MR. HENRY BOWERS, Chester, taken from Marbury Mere, where he says it breeds in some numbers: and from what Lord Combermere writes I have no doubt that it breeds at Combermere also. He says, "There are generally two or three nests every year; they are suspended in the reeds, about two or three feet above the water." Probably breeds also at Oulton and Cholmondeley.

"A few years ago this species might generally be detected as an annual summer visitor to the Bidston Marshes." (Br. p. 6.)

Acrocephalus phragmitis. SEDGE-WARBLER.

"An abundant summer visitor" to Wirral (Br. p. 6), as also to all the low-lying parts of the district. Very common at Edge, and noisy at night [C.W.D.] Common on the marshy ground near the station at Mostyn [W.H.D.]; but rare at Colwyn Bay, if indeed it occurs at all [A.O.W.] Very common by rivers and bogs [T.R.] Not common at Nant-y-ffrith [R.H.V.K.]

Locustella nævia. GRASSHOPPER-WARBLER.

A summer visitor. In some years common round Chester. A nest found in Newton Lane on June 2nd, 1887, by MR. A. POWLES contained six eggs partially incubated.

Not observed at Edge [C.W.D.] Nests annually at Ince, Thornton-le-Moors, and Dunham, but is rarer than at Colwyn Bay, where it breeds freely in the scrub on the mountains [R.N.] Sometimes a duet may be heard in the evening between it and the Nightjar [A.O.W.]

Noted at Prestatyn early in May, 1891. A plaintive high-pitched piping note was made out between the "trills" of its song as it crept along the hedgerow; this was distinct from the 'tic" of its alarm note [H.D.]

Common at Wrexham [A.D.]; and Nant-y-ffrith [R H.V.K.] "Occurs sparingly" at Maesmor [W.J.K.] Not observed near Palé [T.R.]

"A rather scarce summer visitor — Bidston, Bebington, Puddington. A nest has also been found near Upton." (Br. p. 6.)

* **Accentor modularis.** HEDGE-SPARROW.

"An abundant resident" in Wirral (Br. p. 5) as elsewhere.

* **Cinclus aquaticus.** DIPPER.

Common on all the running streams in our Welsh counties, where it regularly breeds. A specimen was shot at the mouth of the Wepre Brook at Connah's Quay [H.D.]; and Mr. A. O. WALKER noted it close to the sea-shore on the Colwyn Bay brook.

* **Panurus biramicus.** BEARDED TITMOUSE.

On January 20, 1894, I purchased a pair of these birds, male and female, from MR. WILLIAM COX, Bird Preserver, Manchester Street, Liverpool. MR. COX informed me that they were shot on the 2nd or 3rd of September, 1893, the male by himself, and the female, after some following up, by a friend who was with him, in a little ditch full of reeds between Hoylake and West Kirby. He brought some of the reeds home, on which the birds have been mounted by MR. NEWSTEAD, and are now in the Grosvenor Museum.

* **Acredula caudata.** LONG-TAILED TITMOUSE.

Resident and common. Usually seen in flocks. Frequently in great numbers, associated with other Tits, in Delamere Forest [R.N.] Breeds throughout the district, *e.g.*, round Chester, Ince, Peckforton, Prestatyn, Colwyn Bay, Palé. Increasing in numbers at Wrexham [A.D.]

"A not uncommon resident" in Wirral. (Br. p. 7.)

* **Parus major.** GREAT TITMOUSE.

"An abundant resident" (Br. p. 6.)

Not so common as *Parus cœruleus.*

* **Parus ater.** COAL TITMOUSE.

A fairly common resident about Chester, but much less common than *Parus palustris.* Not very common at Colwyn Bay [A.O.W.] Not so common as it used to be at Nant-y-ffrith [R.H.V.K.] Scarce round Palé [T.R.]

"A rather scarce resident" (Br. p. 6.) Both Mr. Jebb and Mr. Wolley Dod consider it commoner than the Marsh Tit in their parts.

* **Parus palustris.** Marsh Titmouse.

A very common resident: more general throughout the district than *Parus ater.* Very common at Llangollen [E.C.D.], and Palé [T.R.]; and in winter in Delamere Forest, it accompanies other members of the family; also at Ince, where it frequents gardens in winter, and feeds on the "American blight." Fairly common at Colwyn Bay [A.O.W.]

"An abundant resident" in Wirral (Br. p. 7.)

* **Parus cæruleus.** Blue Titmouse.

"An abundant resident" (Br. p. 6.) The commonest of our Tits.

* **Sitta cæsia.** Nuthatch

A local resident. "Frequently seen in the Chester Cemetery where it undoubtedly breeds" [R.N.] Not uncommon in the Eaton Park, where it breeds. Heard at "The Dale," Chester, in 1893 [D.D.] The late Miss Feilden, Mollington Hall, used to feed them there [W.M.D.] Mr. A. P. White has shot one at Little Budworth. Abundant all the year round at Edge Hall; carries off Indian corn, and eats out the eye [C.W.D.] Heard at Carden [G.W.H.]

In Wales it occurs at Maesmor, but is scarce [W.J.K.] Very rare at Nant-y-ffrith [R.H.V.K.] Mr. A. O. Walker, though on the look out for it, has never heard or seen it at Colwyn Bay, or in our Welsh Counties: and Mr. Ruddy has never observed it at Palé; but Sir H. B. Robertson observed it once at Crogen, Corwen, in the winter of 1868.

Troglodytes parvulus. Wren.

"An abundant resident" in Wirral (Br. p. 9.) So also in all the district.

* **Certhia familiaris.** Tree-Creeper.

"A common resident" in Wirral (Br. p. 9.); also throughout the district.

Mr. R. Newstead informs me that it feeds freely on the common mussel-scale of the apple (*Mytilaspis pomorum, Bouché*), a fact, he believes, not hitherto recorded.

Motacilla lugubris. Pied Wagtail.

"An abundant resident" in Wirral. "I believe a number of these birds leave here in autumn." (Br. p. 7.)

I have seen small companies in Chester, evidently new arrivals, in March.

Abundant in summer at Edge Hall; rare or absent in winter [C.W.D.]

At Colwyn Bay not very common [A.O.W.]

Motacilla alba. WHITE WAGTAIL.

BROCKHOLES remarks—"In April, 1869, I sometimes saw one, sometimes a pair of these birds. Leaving home at the end of the month I did not find the nest near Burton Rocks." (Br. p. 7.)

MR. CORDEAUX, in a letter to me on December 15, 1893, writes—"Some few years ago I saw a pair of White Wagtails (*M. alba*) on the Peckforton Hills, near Beeston."

* Motacilla melanope. GREY WAGTAIL.

A common species on the mountain streams of Wales, where it breeds, *e.g.* on the Dee at Llangollen. Common in MR. RUDDY'S district in summer; a few in winter. In Wirral, not observed by MR. SHARP; while BROCKHOLES says—"Occasional in winter. This bird nests in Lancashire and Flintshire, but I am not certain that it does so in Wirral" (Br. p. 7.)

Rare at Ince. On January 7th, 1884, MR. R. NEWSTEAD saw one feeding with other birds close to his father's house. This bird (a male) was afterwards shot, to make sure of the species [Coll. G.M.]

Motacilla raii. YELLOW WAGTAIL.

"An abundant summer visitor" to Wirral (Br. p. 7.) Common round Chester, Ince [R.N.], Aldford [R.J.S.] Breeds regularly at Nant-y-ffrith [R.H.V.K.] Rare in MR. RUDDY'S district. Never observed at Maesmor [W.J.K.]

Anthus trivialis. TREE PIPIT.

A summer visitor. Fairly common round Chester [W.H.D.], and at Delamere [R.N.]; also at Bagillt, Holywell, and Colwyn Bay [A.O.W.] Common at Wrexham [A.D.], Nant-y-ffrith [R.H.V.K.], and MR. RUDDY'S district.

"Rather scarce in the north of Wirral; abundant at Ness, Burton, and Puddington." (Br. p. 7.)

Anthus pratensis. MEADOW-PIPIT.

"An abundant resident" in Wirral (Br. p. 7.) and the district generally.

* Anthus obscurus. ROCK-PIPIT.

A common resident on the coast. Abundant on the Great Orme's Head, where, as a boy, my attention was first drawn to it by CANON KINGSLEY during a well-remembered walk on July 21st, 1871.

"This bird occasionally nests at Hilbre Island. I have seen eggs which were taken there." (Br. p. 7.)

MR. A. O. WALKER found three nests on Hilbre Island on May 24th, 1858, "Two with young birds; the other with four eggs; all but one hard set."

* **Lanius excubitor.** GREAT GREY SHRIKE.

An occasional visitor. They are sometimes caught in hawk traps in Delamere Forest. A specimen thus obtained in December, 1886, is in the Grosvenor Museum.

One was shot at Eaton Kennels a few years ago [R.J.S.] One at Stanlow by MR. WILLOCK [R.N.]; and one at Dodleston by MR. BECKETT, November 9th, 1893 [T.H.]

* **Lanius collurio.** RED-BACKED SHRIKE.

A summer visitor. Rare about Chester; occasionally seen in fields by the Dee "Cop" [S.C.]

"A pair of these birds reared five young ones a few years ago, near Bidston" (Br. p. 5.)

Mr. SHARP has never met with it in Wirral.

Mr. NEWSTEAD has sent me the following note:—"Nested at Ince in 1883, but is rare, and has not been seen in the district since. Frequent on the Moors above Minera, where I found a nest and young in June, 1890 (Coll. G. M.) The young ones had been fed extensively on the 'Red-tailed Humble Bee' (*Bombus lapponicus*), which abounds on the Moors. In the neighbouring district I also found other Bees impaled by them."

MR. A. T. JEBB has seen a nest at Rhiwlas, near Llansilin.

Mr. RUDDY has seen it occasionally about Llangollen, and says it visits the Merionethshire slip regularly, nesting in tall hedges.

Not common at Colwyn Bay, but breeds at Rhos [A.O.W.]

* **Ampelis garrulus.** WAXWING.

A rare visitor. One was shot at Connah's Quay, January 17th, 1893, and taken to MR. T. HUTCHINSON for preservation; and one "in a lane at Tattenhall," which was presented to the Grosvenor Museum by Mr. R. O. ORTON, but the date is lost.

PENNANT mentions one "killed at Garthmeilio in Denbighshire, in a fir tree, during the severe frost of December, 1788." (*Brit. Zoology, New Ed.*, 1812, *Vol. i., p.* 419.)

** **Muscicapa grisola.** SPOTTED FLYCATCHER.

"A common summer visitor" to Wirral (Br. p. 5), and to most parts of the district. Not common at Colwyn Bay [A.O.W.]

Muscicapa atricapilla. PIED FLYCATCHER.

Cheshire: "On April 30th, 1867, I saw a rather shy, restless bird of this species in a wood at Burton." (Br. p. 5.) One from Hoole, Chester [W.T.]

Flintshire: "One killed in the grounds, Talacre, 1863, early spring." [A. DICK, in diary A.O.W.]

Denbighshire: "A pair nested at Hendre House in 1843-4 (*Annals and Mag., Nat. History*, 1845.) The fact of its nesting in this county was also recorded in '*The Field*' in 1871." (*Zoologist*, Nov., 1893, p. 421.)

This species must be very local even in Denbighshire. MR. RUDDY mentions Chirk and Llangollen as localities, and says it nests in hollow trees. MR. A. T. JEBB (Ellesmere), writes that his father found a nest in Chirk Castle Park. MR. W. J. KERR, of Maesmor, says it "breeds regularly in the district." In the Merionethshire slip it is frequent [T.R.] MR. WYNN has one in the Rûg Collection shot in 1883. MR. STIVENS has one shot at Coed Coch. MR. A. O. WALKER has never observed it at Colwyn Bay.

** **Hirundo rustica.** SWALLOW.

"An abundant summer visitor" to Wirral (Br. p. 9) and all the district.

** **Chelidon urbica.** MARTIN.

"An abundant summer visitor" to Wirral (Br. p. 9), and the district generally. A few years ago it appeared to become far less numerous at Chester, but latterly has re-established itself. Large numbers build their nests on the outside of the railway bridge crossing the canal at Moston, and known as the "Eleven Arches," in a situation, I imagine, exactly similar to that described by MR. SEEBOHM in the Peak district (*History of British Birds*, vol. ii., p. 181.) They obtain their mud from the canal towing path.

MR. R. NEWSTEAD has sent me the following interesting note:—"At Ince quite thirty pairs build their nests on rafters in the *interior* of a barn, and have done so for a number of years. The barn has a large opening without doors on the north side. Such a situation is quite the home of the Swallow, but I never heard of the Martin nesting in the interior of a building."

The difference in habits of the two birds in this respect may be connected with the fact that the Swallow, where there are no buildings, sometimes breeds in caves, and presumably did so before the existence of masonry. The Martin in like circumstances builds in the face of rocks, but as far as I know, not in caves. The record of such a thing would be interesting in the light of MR. NEWSTEAD'S observation. (Consult articles on Swallow and Martin in "YARRELL," Ed. 4, vol. ii., pp. 340 and 349; and "SEEBOHM," vol. ii., pp. 171 and 178.)

Cotile riparia. SAND-MARTIN.

"An abundant summer visitor" to Wirral (Br. p. 9) and all parts of the district suited to its habits.

In the new Rock Cutting of the Manchester Ship Canal at Ince about sixty pairs nested in 1892 for the first time [R.N.]

* Ligurinus chloris. GREENFINCH.

An abundant resident.

"Abundant in summer" in Wirral. "I see a flock occasionally only in winter, and think the majority must go elsewhere for this season." (Br. p. 8.)

** Coccothraustes vulgaris. HAWFINCH.

A not uncommon resident in West Cheshire, and, I think, increasing in numbers: more frequent in the winter months, but breeding in several localities, *e.g.* on the Eaton estate [H.G.] and at Saighton [R.J.S.], Mollington, Ledsham, and Ince [R.N.] Very shy in the breeding season [H.G.] Common at Ashton Hayes among yew trees [G.W.H]

A young bird taken at Ledsham lived for eighteen months on little else than dry peas [R.N.]

On November 30th, 1891, an adult male was found in a dying condition by MR. CECIL SMITH, Blacon. Its plumage was in splendid order, but it was very thin and appeared, from *post-mortem* examination, to have died of tuberculosis [R N.]

Not included in BROCKHOLES' list.

MR. WOLLEY DOD writes to me from Edge Hall: "They have bred here for more than twenty years, ever since I came to live here I suspect they breed on the high trees, but I have never looked for their nest. They destroy many peas in the pod, but the most remarkable evidence of their presence is beneath the yew trees. When the berries get nearly ripe, about September, the ground beneath them becomes covered with small twigs with one or two unripe berries on each. I used to think it was done by Squirrels, but I have now become certain it is by Hawfinches. If I get under the tree stealthily I can generally hear their shrill wee chirp. There are two large yew trees under which the twigs are strewn so thick that I have had more than a wheelbarrowful swept up at once, and in a fortnight they will be as thick again."

In our Welsh counties it appears to be more rare. Noted some years ago near Llandudno [H.T.]; and one was shot at Coed Coch [A.O.W., author. MRS. LLOYD-WYNN's butler]. Not observed by MR. A. O. WALKER at Colwyn Bay, or by MR. W. H. HEATON at Denbigh; but MR. JOHN BARNARD has known of them being shot at Llandyrnog, and himself shot a young bird in 1892. One was caught at Wrexham in 1890 [A.D.]

In 1891 one killed itself by flying against a window at Penywern, near Mold [R H.V K.] Young birds seen in autumn at Maesmor [J.W.K.] One "killed at Nannerch, E. C. WILLIAMS" [A. DICK]. Occurred in some numbers at Llangollen in 1888, and was first observed at Palé in the same year; seen occasionally since in both localities [T.R.]

Carduelis elegans. GOLDFINCH.

Resident and generally distributed, but not common in Cheshire.

Breeds at Aldford: two nests in 1893 [R.J.S.], one of these in the branch of a pear tree, was obtained for the Grosvenor Museum after the young had flown.

In Wirral "a scarce resident. Birdcatchers say that a good many come here in autumn" (Br. p. 8.) Small flocks sometimes seen in winter [W.E.S.] Not common at Burton [W.C.]

Fairly common at Combermere [Lord C.] Scarce at Ince [R.N.] Occasionally seen at Manley [A.J.N.] Sparingly at Edge Hall in summer; breeds in the gardens; abundant in flocks in winter [C.W.D.]

In Wales it is commoner. MR. RUDDY has noticed flocks of fifty in winter, and says it breeds in June, usually high up in larch trees. Breeds in large numbers near Maesmor [W.J.K.], but is not so plentiful as formerly [W.K.] Young bird noted in the Ceirog Valley, June, 1893 [S.C., W.H.D.] Very common at Llandyrnog [J.B.] Fairly so at Colwyn Bay [A.O.W.] and Abergele [J. H.] Noticed also on the Dee Cop [S.C., D.D.] and at Saltney, Connah's Quay, and Prestatyn [R.N.] Not common at Wrexham, but occasional flocks seen in winter. [A.D.]

* **Chrysomitris spinus.** SISKIN.

I have never observed it in the neighbourhood of Chester, and it is not in BROCKHOLES' list; but MR. SHARP, Ledsham, writes—"In the winter of 1872-3 this bird was most abundant in the birch trees. I have never seen it in any numbers since."

MR. R. NEWSTEAD, Senr., had two specimens in his collection from Tarporley, where it is said to occur annually in autumn and winter [R.N.] A female was shot at Ince Hall, November 1st, 1891, by MR W. NEWSTEAD [Coll. G.M.] MR. WOLLEY DOD says he has often seen flocks eating the alder seeds in winter.

In Wales it is more common and probably breeds. MR. A. O. WALKER heard it singing at Llangollen on April 7th, 1882.

"MR. KERR records (*Zool.*, ss. 3410) the appearance of a flock of about twenty, almost all young of the year, in Denbighshire, August 6th, 1872, suggesting the possibility of their having been bred in the vicinity." ("YARRELL," Ed. 4, ii., p. 128.)

Mr. Ruddy notes—"Large flocks in winter. Food: Seeds of alder and birch trees."

Now and then in winter at Nant-y-ffrith [R.H.V.K.]

Noted in March at Abergele [J. H.]

* Passer domesticus. House-Sparrow.

Abundant everywhere. Mr. Newstead records that he has twice seen it feed its young with "Daddy Long-legs" (*Tipula Sp.*) On the first occasion at Upwell, Cambs., some years ago; on the second at Thornton-le-Moors, in August, 1893.

* Passer montanus. Tree-Sparrow

Not uncommon on the north side of Chester; making Brockholes' information a probability, viz.:—"I am assured this bird nests near Bache House, Chester." (Br. p. 8.)

Mr. Ecroyd Smith found it breeding at Hooton, on April 28th, 1866 (*Liverpool Nat. Journ., Sept*, 1866, *p.* 54.)

Breeds at Upton [E.C.D]. and Backford (1889) [R.P.B.], and occasionally at Ince, where it is fairly common [R.N.]

Mr. R. H. V. Kyrke, Nant-y-ffrith, notes it as very rare, and adds: "have only once taken its eggs. This nest was taken near Wrexham about twenty-five years ago." This is the only record, as far as I know, of its nesting in Wales, except in Breconshire. Mr. Ruddy has not observed it in his district.

Mr. S. Cummings and I observed it in the Ceiriog Valley, in June, 1893. One "killed near Nannerch, E.C.W." [A. Dick.]

* Fringilla cœlebs. Chaffinch.

"An abundant resident" in Wirral (Br. p. 8.), and throughout the district, breeding wherever there are trees, and often collecting into flocks in winter.

* Fringilla montifringilla. Brambling.

A winter visitor; in some years numerous near Chester; usually, I think, in January and February. A regular visitor to Ince; often in great numbers [R.N.] In 1883 they arrived in this locality in the early autumn, which is quite unusual [R.N., Senr.]

In flocks at Edge, generally towards the end of winter [C.W.D.] Not common at Aldford [R.J.S.]

Mr. Ruddy notes—"Large flocks in winter from October to March, feeding on Beechmast, Haws, &c."

Also at Maesmor [W.J.K.] and Wrexham [A.D.]; and Mr. R. H. V. Kyrke notes having seen it once or twice "in the late spring months."

A note of the late MR. PRICE mentions them as repeatedly seen in hard weather under the beech trees at Pwll-y-crochen, Colwyn Bay, and once at Llysfaen.

"An occasional visitor" to Wirral. "I have seen this bird in March only." (Br. p. 8.)

* **Acanthis cannabina.** LINNET.

"An abundant resident" in Wirral (Br. p. 8) and the district generally.

* **Acanthis rufescens.** LESSER REDPOLL.

A common resident about Chester; but noted by MR. R. NEWSTEAD as rare on the south side (see p. 279.) Frequent on the Dee "Cop," where it breeds [S.C.] I have found the nest also between Upton and Chorlton.

In Wirral, BROCKHOLES notes it as "a rather scarce resident" (Br. p. 8); but Mr. SHARP, Ledsham, says it was "formerly rather common there, nesting in woods and by the side of pits."

Very common at Ince in winter [R.N.]

In Wales it is very common at Maesmor, and breeds regularly in the district [W.J.K.]; and Mr. RUDDY notes "large flocks in winter, and a few stay to breed in the hilly districts. Found a nest with eggs and observed two pairs of birds on May 14th, 1893. Fond of the seeds of the alder and birch trees."

Found nesting once near Wrexham [A.D.] Not common at Nant-y-ffrith [R.H.V.K.]

Must, I think, be rarer also along the coast. At Abergele, is to be seen in small flocks on alders occasionally [J.H.]

Only once seen at Llandudno by Mr. H. THOMAS.

Acanthis flavirostris. TWITE.

A species easily overlooked, and difficult to get accurate information about. MR. COWARD, Bowdon, tells me that he has seen it in the breeding season on Carrington Moss, and it is therefore worth looking out for near our eastern boundary line.

Mr. RUDDY states that both he and the late Mr. BECKWITH, though constantly on the look out, have failed to identify it. Mr. J. R. KERR, too, states that he has not observed it within our district, though he has found it breeding in North Wales. MR. R. W. J. KYRKE says it occurs at Nant-y-ffrith in autumn winter, and spring, but is not as common as it used to be.

Mr. W. H. HEATON says he has seen it in the Vale of Clwyd district from June to September, but never met with a nest.

Mr. HANNAH, Abergele, says it occurs there, but he has only seen it in winter.

MR. SHARP, Ledsham, says he has seen it at Berwyn, but never in Wirral.

* **Pyrrhula europæa.** BULLFINCH.

"A common resident in Wirral" (Br. p. 8) [W.C.] and generally throughout the district, *e.g.* at Ince [R.N.], Combermere [Lord C.], Edge [C.W.D.], Aldford [R.J.S.], Wrexham "some years" [A.D.], Nant-y-ffrith [R.H.V.K.], Maesmor [W.J.K.], Rûg [C.H.W.], Colwyn Bay [A.O.W.], Abergele [J.H.], Llandyrnog [J.B.], Llandudno, "but more numerous towards the village of Mochdre" [H.T.] Very common at Llandulas [L.J.D.] Common in gardens and fir plantations; feeds on buds of plums, and small fruits, groundsel, &c. [T.R.] Not very common close round Chester. Often seen on the road to Wervin [T.S.P.]

* **Loxia curvirostra.** CROSSBILL.

An occasional winter visitor in flocks. Is not included in BROCKHOLES' list of the birds of Wirral; but in MR. CONGREVE'S collection there is a specimen shot in the Burton fir woods, January, 1839.

In Delamere Forest MR. W. J. BEAUMONT noted the occurrence of a flock of about twenty on January 22nd, 1889 (*Naturalist*, Ap., 1889, p. 102); and on and after December 10th, 1889, MR. COOKSON, Oakmere, shot two adults and five immature from a small flock. (Three of these in Coll. G. M.)

Of its occurrence in Wales MR. RUDDY writes—"You may safely put this down as a Denbighshire bird. Besides many observed at Palé, I saw several by the side of the canal between Llangollen and Berwyn Station in the winter of 1887-8, when I had to go regularly to superintend the gardens at Llantysilio. The favorite food was the seed of the larch, but I watched them eating the seeds of the sycamore trees too. The birds were fearless; I could almost catch them with my hand before they would move. I only knew of one specimen in this part before 1887, and have not seen any since."

SIR H. B. ROBERTSON noted several at Nantclwyd, near Ruthin, in the same winter, 1887-8.

MR. W. J. KERR says that it occurs at intervals in the Maesmor district and that he has shot several.

Two in Coll. G.M., presented by MR. J. POWNALL, were shot in Bryn Tyrion Woods, near Corwen, Februaiy, 1890.

* **Emberiza miliaria.** CORN BUNTING.

Though not abundant, this species occurs on the cultivated land bordering the coast from the Mersey to the Conway.

BROCKHOLES says: "I have never seen this bird here" (in Wirral) "in winter. It is here in March, remaining during spring and summer. It is common then in places such as Wallasey and the enclosed portions of the Dee marshes." (Br. p. 7.)

It is then found also in fields near the Dee Cop [S.C.,W.H.D.], at Saltney (heard July 27th, 1893) [R.N.], Rhyl [W.H.D.], Abergele [J.H.], Colwyn Bay [A.O.W.], and Llandudno, in the fields between the Ormes [A.M.]; also in the Vale of Clwyd, but scarce [T.R.] I heard it singing and saw the bird at Prestatyn, on February 5th, 1894. Not observed in the Corwen slip of Merionethshire [T.R.]

At none of these places is it anything like so common as at Holyhead, where, with the help of Mr. BANKS, I obtained a nest in June, 1892. It was hidden deeply in the hay-grass, some inches from the root of an umbelliferous plant, from which a sort of "run" led to the nest, as if the plant were rather a landmark than a shelter. HOWARD SAUNDERS seems to suggest that it is used as a perch. (*Manual, p.* 200.)

It also occurs, though sparingly, in winter. Mr. NEWSTEAD, SEN., had one that was shot at Ince, December 24th, 1889; and MR. R. J. SMITH, Aldford, sent one to the Grosvenor Museum, on Jan. 10th, 1894.

* **Emberiza citrinella.** YELLOW BUNTING.

"An abundant resident" in Wirral (Br. p. 8), and throughout the district.

Emberiza cirlus. CIRL BUNTING.

An isolated colony exists in the Ceiriog Valley, Denbighshire, as noted by MR. A. V. APLIN, on the authority of MR. C. G. BEALE of Edgbaston, who formerly had a shooting at Glyn. He found it from there down to Chirk, but commonest for about a mile below Glyn; and it was absent four miles higher up the Valley at Llanarmon Tower. (*Zoologist,* May, 1892, p. 179.)

This colony I have twice visited; the first time on July 23rd, 1892, when I both heard and saw a cock bird at the village of Dol-y-Wern; the second on June 3rd, 1893, with MR. S. CUMMINGS, when we came across two broods of young, just fledged; caught one of the young birds, and saw the females. MR. CUMMINGS, who is familiar with this species in Devonshire, can at once distinguish the note of the young from that of the young Yellow Hammer; the former being sharper and less prolonged.

MR. BEALE once (and only once) heard it about Llangollen.

Emberiza schœniclus. REED BUNTING.

Common in suitable localities. Breeds in the Mollington meadows, near Chester, and at Aldford [R.J.S.]

In Wirral, "a partial migrant, abundant in summer; a few remain all winter" (Br. p. 8.) Frequents every pond side in the district [W.E.S.]

Breeds abundantly on the Ince and Helsby marshes [R.N.]

In the Delamere district, by Little Budworth Mill Pond [A.P.W.]

In Wales, on the banks of the Dee, near Wrexham [A.D.]; and common and general in Mr. RUDDY'S district, where it nests under the shelter of a furze bush or tuft of grass [T.R.]

Not noted at Colwyn Bay [A.O.W.] or Llandudno [H.T.]

* **Plectrophenax nivalis.** SNOW BUNTING.

Noted by BROCKHOLES as "a rather scarce winter visitor" (Br. p. 7.)

Mr. NICHOLAS COOKE mentions a specimen caught at Leasowe, December, 1866 (*Lanc. Nat. Journ., Jan.*, 1867, *p.* 104.) One was taken on the Sandhills at New Brighton a few years ago [W.B.]

MR. J. F. ROBINSON captured two out of a flock that he observed for two days, at Frodsham, in the severe winter of 1880-1 (*Manchester City News*, August 19th, 1882) [T.A.C.]

Often in winter, along the shore at Pensarn. Mr. HANNAH (Abergele) writes—"I have myself seen them three or four winters, and often hear of them. My friend saw some this winter (1893-94.) The specimens I have were shot on November 30th and December 20th, 1888." Mr. A. O. WALKER observed it some years ago at Bagillt; shot a specimen on the shore at Colwyn Bay, January 11th, 1894 [Coll. G. M.]; and observed two more a week later.

The late Mr. J. PRICE mentions having seen it "when a schoolboy, on the banks of the Afon Ganol, Llandrillo, near Colwyn Station" (*Lanc. Nat. Journ*, *May*, 1867, *p.* 129.); and Mr. STIVENS has one shot by Mr. PRICE, out of a flock of five or six, between Llandudno and the Little Orme, about 1873.

Visited Llandudno during a severe winter about 15 years ago [H.T.]

Is occasionally shot on the Berwyns [T.R.]

Observed twice at Maesmor [W.J.K.]

At Wrexham, a flock seen repeatedly 20 years ago in winter [A.D.] MR. R. H. V. KYRKE has seen three near Nant-y-ffrith Reservoir, in November.

Mr. A. T. JEBB (Ellesmere), in an address on the birds of the lake district about Ellesmere and the hill district about Llansilin, says—"I have seen Snow-Buntings twice on a high hill near Llansilin."

* **Sturnus vulgaris.** STARLING.

Common everywhere. "An abundant resident and partial migrant. Countless thousands congregate in the autumn evenings to roost at Caldy and Thurstaston. The majority of these migrate before winter begins." (Br. p. 8.)

Pastor roseus. ROSE-COLOURED STARLING.

MR. A. DICK notes that one was "killed at Point of Air (circ. December), 1862, at lighthouse." [A.O.W.'s diary.]

Pyrrhocorax graculus. CHOUGH.

PENNANT says: "Several of the Welsh and Cornish families bear this bird in their coats of arms. It is found in Cornwall, *Flintshire*, Carnarvonshire, and Anglesey, on the cliffs and castles along the shores." (*Brit. Zoology, Ed.* 1812, *vol. i., p.* 295.)

Mr. R. NEWSTEAD suggests that it may have nested in Flint Castle; but the statement in "YARRELL" (*British Birds, Ed.* 4. *ii., p.* 255) that "round Wales a good many spots, chiefly in the counties of Glamorgan, Pembroke, Anglesey, *Flint, and Denbigh*, appear to be still inhabited by the Chough," cannot, I feel sure, be now correct as regards the two last counties; still less Mr. SEEBOHM'S statement (*Brit. Bds., vol. i., p.* 576), that it still breeds in them.

The latest record of its occurrence in our district, which I have been able to discover, is that of BROCKHOLES, who says—"Some years ago I met with a flock of these birds in a field at Leasowe." (Br. p. 8.)

There is, however, evidence that it formerly bred in Denbighshire and on the Orme's Heads. MONTAGU states (*Dict. of Brit. Birds*, NEWMAN'S Ed., 1886, p. 41): "A pair of these birds had for many years bred in the ruins of Crow Castle, in the vale of Llangollen, in Denbighshire. By accident one of them was killed, and the other continued to haunt the same place for two or three years without finding another mate"; and the REV. R. WILLIAMS writes in his "*History of Aberconwy*," published in 1835—"*Corvus graculus*. Chough. *Bran big Coch*. These birds are rather numerous in this neighbourhood, and they breed on all the rocks."

* **Nucifraga caryocatactes.** NUTCRACKER.

The first known occurrence of this species in the British Isles was in our district, being recorded by PENNANT as shot near Mostyn, Flintshire, October 5th, 1753 (*British Zoology, ed.* 1812, *vol. i., p.* 298.)

We cannot boast of having this very ancient specimen in our Museum Collection, but we have a more recent one, a male (No. 1617), which was shot at Vale Royal, Delamere, Cheshire, in the year 1860, and sent in the flesh to the late Mr. WM. THOMPSON, of Chester, who afterwards sold it to Mr. A. O. WALKER. The exact date was unfortunately not kept. For this information I am indebted to Mr. NEWSTEAD, who obtained it direct from MR. THOMPSON.

* Garrulus glandarius. Jay.

A common resident, and general throughout the district.

Abundant in Delamere Forest, where it is much commoner than the Magpie; the reverse was the case at Colwyn Bay about 1887 [R.N., A.O.W.]; but Jays are certainly the commoner now, and have been so for the last four or five years [A.O.W.] Scarce at Ince [R.N., Sen.]

Mr. George Hayes says that in October, 1893, Jays used to come to and fro between Ashton Hayes and Delamere Forest regularly, for many days, for acorns. By getting in the line of flight he shot over fifty. Every bird which came from the forest had its gullet empty, while every one which returned had five or six acorns, and always one in its bill, which dropped out when it was shot. Were they going to store them up, or would they pass on into the stomach and be digested? Mr. Newstead has observed broken up acorns without their skins in the gizzard of a Jay.

"A much persecuted resident." (Br. p. 9.)

** Pica rustica. Magpie

"A much persecuted resident" (Br. p. 9.)

Not very common about Chester. Saw fifteen or twenty on the banks of the Weaver, in 1893 [L.G.] Flocks of this size may often be seen at Ashton Hayes [G.W.H.] Very common at Colwyn Bay, a few years ago [R.N.]; but not now [A.O.W.] Frequent in the Merionethshire slip, but much persecuted [T.R.]

Corvus monedula. Jackdaw.

"A common resident" (Br. p. 9.)

* Corvus corax. Raven.

Brockholes says: "In the spring of 1857, a pair of Ravens had a nest on the west side of Hilbre Island. For many years Ravens were abundant in winter on the Dee marshes, but I have not seen one since about the year 1866. I believe they were poisoned on account of the injury they do to sheep. I have known Ravens to pick the eyes out of apparently a sound, healthy sheep, whilst resting, and so cause its death. After the eyes, the tongue, and then the liver were the favourite morsels" (Br. p. 8.)

One in Mr. Congreve's Collection, labelled "Burton, 1840."

In Wales it occurs regularly, *e.g.*, at Llandyrnog [J.B.], Maesmor [W.J.K.], and Mr. Ruddy's district. He says it "nests on the Denbighshire side of the Berwyns, and is often seen hunting." Often seen about the Rhiwlas Hills, near

Llansilin, in winter [A.T.J.] Formerly it used to breed in the Eglwyseg Rocks, at the World's End, Llangollen, but now only occurs there in winter [R.N.] At Nant-y-ffrith is now rare, but some twenty-five years ago a pair began to build in two consecutive seasons [R.H.V.K.]

Formerly bred on the Orme's Heads, and possibly does so now. The late MR. ECROYD SMITH stated on the authority of a farmer who lived on the spot, that one pair each year remained masters of the Little Orme's Head after driving all others of the same species away. They were gregarious in winter (*Liverpool Nat. Journ.*, August, 1867, p. 16.)

There is a specimen in the Grosvenor Museum from Moel Gyw, Ruthin, which was shot in 1862; and one from Rûg, trapped in 1891, presented by MR. VAUGHAN WYNN.

* **Corvus corone.** CARRION CROW.

"A very few years ago this bird was common on Sealand, Shotwick, Burton, Saughall, and Puddington. The Crow shared the fate of the Raven, and at the same time. Ending with the year 1865, nests were common in the above-named parishes and townships, but I have not seen any since. An occasional Crow may still be heard whilst passing through the country." (Br. p. 9.)

This bird, however, still breeds in Wirral; for instance near Mollington [R.P.B.] Seen occasionally in winter on the marshes between Stanlow and Frodsham [R.N.] Common in some parts of the district, as Colwyn Bay, where it breeds [R.N., A.O.W.]; and Talacre [Sir P.M.] In the Merionethshire slip it nests on trees regularly in the hilly dingles [T.R.]

MR. GARLAND informed MR. NEWSTEAD that for several years great numbers have congregated during autumn and winter in the duck-wood at Eaton, where they roost, and remain in spite of persecution.

* **Corvus cornix.** HOODED CROW.

Of rare occurrence. Not in BROCKHOLES' List of the Birds of Wirral; but MRS. LONGUEVILLE, Upton Cross, Chester, who lived at Hoylake between 1810 and 1836, and again between 1840 and 1854, tells me that during both periods she remembers seeing the "Royston Crows" not infrequently in winter. Their arrival was watched for by those interested in birds. They used to feed on Mussels at Hilbre Point, and flying up to some height, let them drop upon the rocks known as the "Red Stones" to break them. She has seen them treat Crabs in a similar manner.

A specimen was shot by MR. SHELLCROSS in 1882, on the banks of the Mersey at Ince [Coll. G. M.]

A flock of seven or eight were seen near Ledsham in November, 1888; two of these were shot; one is in the Grosvenor Museum, the other was in the collection of the late MR. STRETCH, Ledsham [R.N.]

MR. TOWNSHEND LOGAN tells me he saw one shot at Aldersey a few years ago; and the late MR. WM. THOMPSON had one for preservation from Eaton Park.

MR. RUDDY writes: "Rare in the Merionethshire slip. One was shot at Llanderfel on November 16th, 1887. It was eating part of a dead rabbit, on the knoll overlooking the village. None of the gamekeepers about this district ever saw a bird like it before. It is now in the collection of MR. W. P. WILLIAMS, London."

* **Corvus frugilegus.** ROOK.

An abundant resident. (Br. p. 9.)

** **Alauda arvensis.** SKYLARK.

"An abundant resident" in Wirral (Br. p. 7.), and throughout the district. BROCKHOLES adds; "I believe this to be a partial migrant, as I have seen flocks crossing the Dee marshes in autumn, in a southerly direction, apparently bent on a journey; numbers stay here in winter. The species is increasing numerically in Wirral."

In the Merionethshire slip this bird is common on the uplands at an altitude of 800 to 1000 feet. It only visits the low-lying meadows by the Dee when driven by severe weather [T.R.]

Alauda arborea. WOODLARK.

Apparently very rare, but perhaps over-looked.

"In April, 1859, I saw a rather wild uusettled bird at Claughton, near Birkenhead. In May, 1861, I saw a pair of birds, but failed to find the nest, Burton." (Br. p. 7.)

SIR H. B. ROBERTSON shot one at Palé on December 23rd, 1875, now in his collection; and MR. RUDDY has since observed it in autumn.

Mr. NEWSTEAD tells me that he both saw and heard a male in the spring of 1885, in the Bryn-y-glyn Wood, near Colwyn Bay.

MR. BYERLEY states in 1854, on the authority of MR. MATHER, Taxidermist, Liverpool, who would be likely to note the frequency with which he received specimens, that it was "plentiful twenty years ago; now never seen." (*Fauna of Liverpool*, p. 13.)

Order PICARIÆ.

** Cypselus apus. SWIFT.

"An abundant summer visitor." (Br. p. 9.) At Chester it arrives during the first week of May. On May 19th, 1890, I came suddenly upon a pair of Swifts on the ground on the foot pavement of King Street, screaming loudly and apparently in conflict. After a few seconds they took flight; one appeared to rise at once from the curb stone, the other had more difficulty, and following the slight downward incline of the street, was heard to beat the pavement eight or ten times with strokes of its wings before it could rise clear.

I have also seen a Swift settle upon the perpendicular wall of our house, under shelter of a spout, and remain there for two hours during a heavy shower of rain.

[Cypselus melba. ALPINE SWIFT.

MR. BYERLEY mentions, on the authority of MR. MATHER, Taxidermist, that one was killed at the mouth of the Dee, many years ago, by — MOSTYN, ESQ. (*Fauna of Liverpool*, 1854, p. 16.)]

* Caprimulgus europæus. NIGHTJAR

"An abundant summer visitor to the fir woods of Bidston, Storeton, Ness, and Burton, also to the open heath of Bidston Hill." (Br. p. 10.) Its nesting on Bidston Hill in 1886 is described in "*Research*" (Aug., 1888, p. 28.) An egg in the Grosvenor Museum was obtained from the same locality in 1893. MR. SHARP obtained a pair of eggs at Burton last year also. ECROYD SMITH mentions Caldy Hill and Thurstaston as other localities in Wirral where it breeds.

It is also a fairly common species in other suitable parts of the district—Delamere Forest, Little Budworth Common [A.P.W.] Edge, where it breeds on the heather hills, and where it occasionally frequents woods [C.W.D.]; Helsby Hill [R.N.] (*Spec. Coll. G.M., Aug.*, 1884); and in Wales, Abergele [J.H.], Colwyn Bay [A.O.W.], Llandyrnog [J.B.], Maesmor [W.J.K.], and MR. RUDDY'S district, where he has observed it catching the Ghost Hawk Moths in the evening.

Iÿnx torquilla. WRYNECK.

A summer visitor of very rare occurrence A pair nested in the trunk of an old Poplar at Oakmere, about the year 1884. The female and seven eggs were taken, and the eggs given to the (then) head keeper at Vale Royal [R.N.] "Heard near Mostyn in spring, 1861; V. GOSFORD." [A. DICK.]

MR. W. H. HEATON, of Reigate, where the bird is plentiful, writes—"I am quite certain about having frequently heard the note of the Wryneck at Plas Heaton, near Denbigh, at various times, from as early as 1846 to as late as, say, 1869; Gwas-y-Gog it is called there. I have not been in the country during March and April for more than a day or two at a time since 1870. A nest was once brought to me, or rather the eggs, in, I think, 1866. I was at the time satisfied about them, but have not got them now." "Gwas-y-Gog" is, I believe, the Welsh for "Cuckoo's Mate," by which name this bird is often known; but MR. RUDDY writes: "Any little bird following the Cuckoo is in this part of Wales (Merionethshire) called the "Gwas-y-Gog; the Wryneck is unknown."

* **Gecinus viridis.** GREEN WOODPECKER.

Pretty generally distributed. Rare about Chester. Noted near Mollington [S.C.] BROCKHOLES notes it as "an occasional visitor at all seasons; and I believe it occasionally nests in Wirral." (Br. p. 9.)

Occurs at Ince occasionally [R.N.] Nested at Stanlow some years ago [R.N.] Nests annually in an old beech tree near Bolesworth Castle [R.N.] Has bred at Eaton [H.G.], and frequently in Delamere Forest, where it is common [R.N.] Fairly common at Combermere [Lord C.] Very abundant at Edge [C.W.D.]

In Wales it is common at Maesmor [W.J.K.], and in Mr. RUDDY's district. Occurs near Wrexham [A.D.]; Llandyrnog [J.B.]; Moel Fammau district [T.H.]; and along the coast at Abergele [J.H.]; Gloddaeth, near Llandudno [H.T.]; and Colwyn Bay, where it was frequently heard and seen in 1884-5-6 [R.N.], but is becoming scarce [A.O.W.]

* **Dendrocopus major.** GREAT SPOTTED WOODPECKER.

General, but not abundant in the district. Rare about Chester, except on the Eaton estate, where it breeds [H.G.] MR. NEWSTEAD was shewn a deserted nest there in 1888, and saw a specimen of the bird on Nov. 29th, 1893. I had a specimen from Moston Hall, some years ago [Coll. G.M.]

In Wirral "an occasional visitor. Perhaps it is a scarce resident. In May, 1860, there was a nest in Patrickwood, near Bromborough Mills." (Br. p. 9.) I have seen a pair which were shot in DR. BELL's garden at New Brighton in 1887.

MR. W. L. HAYMAN, Liverpool, writes in the *Field* (vol. xxvii., January 27th, 1866, p. 77): "In the month of July, 1865, a friend of mine, a naturalist, had four young Great Spotted Woodpeckers brought to him from near Hooton Hall, Hooton." [T.A.C.]

It occurs at Ince [R.N., Sen.], and is not uncommon in Delamere Forest, where MR. NEWSTEAD found a deserted nest in an oak tree a few years ago. Three from this locality were in the Collection of MR. LEATHER, Delamere Lodge. One was killed at Broxton, January, 1891 [R.N.]

Mr. Wolley Dod writes: "I never found the nest of the Great Spotted Woodpecker here, but there were more than two about last spring (1893). I used to hear them daily, mostly on a hollow beech, and my keeper told me he watched them fighting for a hole in the tree, three together, in April. I did not find that any stayed to breed. I do not think this species is always here. They frequent hedge-row trees as much as woods.

In Wales it occurs in Mr. Ruddy's district; also at Maesmor, where it breeds [W.J.K.], and Llandyrnog [J.B.]

***Dendrocopus minor.** Lesser Spotted Woodpecker.

Not common, but has been obtained from many parts of the district. It is not included in Brockholes' list; but I am informed by Mr. W. Cox, Taxidermist, Liverpool, that he has received several specimens from Eastham Woods, which is the best place he knows for Woodpeckers.

Mr. Garland shewed me a hole near his house in the Eaton Park, where a brood had been successfully reared by the hen bird, after the cock had been accidentally killed. Mr. R. J. Smith shot one at Saighton [Coll. G. M.]

At Ince several have been seen or heard since 1884; and during the autumn of 1893 one frequented some tall Elms for several weeks [R.N.] A specimen from this locality was obtained by Mr. R. Newstead, Senior [Coll. G.M.] In June, 1886, the late Mr. Thompson had one from Tiverton for preservation.

Mr. Wolley Dod writes: "It is plentiful at Edge Hall, beginning to 'rattle' in February, and often close to the house. I have watched them carefully, and have no doubt that the movement of the head in rapping is vertical, and not as used to be said, from side to side."

In Wales it has been observed about Llangollen, but is rare [T.R.]; also at Nan-y-ffrith [R.H.V.K.], Glan Conway [C.B.], and near St. Asaph [W.H.H.]

Coracias garrulus. Roller.

Mr. A. O. Walker tells me that on January 21st, 1858, he saw a Roller which had been shot by Capt. Mostyn at Saethaelywyd, near Holywell, in the previous September.

One shot at Abergele by Mr. C. Jeffreys, October 19th, 1874 (*Field.*)

*** Alcedo ispida.** Kingfisher.

A generally distributed but rather scarce resident. Comes close to the city of Chester in the winter, and has nested twice to my knowledge within two miles since 1890. Occasionally seen on the Dee near Eaton; and Mr. Congreve has observed it on the marsh at the mouth of the river. Probably breeds at Ince, but is scarce [R.N.] Fairly common at Combermere [Lord C.] and Little Budworth [A.P.W.]; and at Edge Hall, where it is carefully preserved [C.W.D.] On the banks of Dee and Alyn [A.D.]; but Mr. R. H. V. Kyrke says that about fifteen years ago they seemed to die off wholesale, and to become nearly extinct there. Frequent along the Dee in the Merionethshire slip, and on the upper part of the Clwyd [T.R.] Almost or quite extinct at Colwyn Bay [A.O.W.]

"A rather scarce resident. It is much sought for its beauty." (Br. p. 5.)

Upupa epops. Hoopoe.

Mr. A. O. Walker has seen a stuffed Hoopoe at Coed Coch, which Mrs. Lloyd-Wynne, a reliable authority, told him was shot on the lawn there. This was confirmed by the old butler, whom Mr. Walker saw on January 24th this year. He says it was fifteen or sixteen years ago.

Mr. Walker discovered the following note in an old *Chester Courant*: "A very curious bird was shot on Sunday morning in the garden of Mrs. Bolds, of the Bars, in this city. It is accurately described by Pennant in his Zoology as the Hoopoe; has a beautiful crest, which it raises or falls at pleasure when alive. It is found in some parts of Europe, in Egypt, and even as remote as Ceylon in the East Indies Adam." (*Chester Courant*, September 11th, 1792.)

* **Cuculus Canorus.** Cuckoo.

An abundant summer visitor. (Br p. 9.) The usual birds chosen as foster mothers in our district are the Meadow-Pipit, Hedge-Sparrow, and Pied Wagtail; Mr. Cookson mentions also the Skylark and Yellow-Hammer; and Mr. W. H. Heaton the Tree-Pipit; while Lord Combermere, Mr. R. H. V. Kyrke, and Mr. R. Newstead, Senr., all note the Robin; an observation recorded also by Mr. Ecroyd Smith, at West Kirby. (*Liverpool Nat. Journ., Sept.*, 1867, *p.* 166.)

A most interesting account of a Cuckoo and a Swallow being reared in the same nest at Edge Hall, near Malpas, was published by the Rev. C. Wolley-Dod in the *Ibis* for October, 1892 (p. 524.)

Order STRIGES.

* **Strix Flammea.** Barn-Owl.

A fairly common resident, and generally distributed. Nested annually in the old tower of Chester Cathedral before its restoration. For some years a pair have bred under the roof of Abbots' Lodge, Liverpool Road, Chester. Mr. Henry

BOWERS tells me that the old birds remain all winter, but the young leave in August. In 1893, MR. HERBERT BOWERS noted that the young ones left about the third week in August, and he saw the old birds going out for the night one evening in December. MRS. LOWE had the greatest difficulty in expelling them from a house on Hough Green, where they had taken up their abode, and were causing damage to the roof, some years ago. The same attachment to houses in populous suburbs is noted by MR. W. E. SHARP, who writes—"a pair bred for years in the eaves of a villa-house in Bebington; and another pair in a house near Birkenhead Park."

"Resident" in Wirral, "but not so common as formerly." (Br. p. 5.)

MR. RUDDY reports it "resident and common" in his district, "although much persecuted."

* **Asio otus.** LONG-EARED OWL.

Resident, and not uncommon. There are specimens in the Grosvenor Museum from Delamere Forest (where it is said to breed [R.N.]), Mold, Bathafarn, and two young, in down, from Saughall. Used to breed at Colwyn Bay, and in Llangwstenin Wood [J.P.] Occurs on the Eaton Estate, where it breeds [H.G.] MR. C. BRADBURY took a nest in Stanney Wood in 1891.

BROCKHOLES notes: "Resident in the fir woods of Bidston, Prenton Mount, Storeton, Ness, and Burton. Sometimes also in mixed woods where there are Scotch firs, such as Badgers' Rake Wood, Ledsham. There are seldom more than one pair of old birds in a wood. Nidification commences in March. This Owl never makes a nest for itself, but simply repairs the old one of a Sparrow-hawk, Crow, Magpie, or Wood-pigeon." (Br. p. 4.)

Resident in the Merionethshire slip; found a nest with young birds in an old Squirrel's dray, in May, 1874 [T R.]

* **Asio accipitrinus.** SHORT-EARED OWL.

A regular visitor in autumn and winter. MR. GARLAND tells me he has also seen it *in summer* on the Eaton Estate.

A specimen in the Grosvenor Museum was shot at Ince in 1885, and another at Sealand in the autumn of 1887. MR. DRINKWATER says it occurs also at Cholmondeley.

In Wales, "often on the moors in winter" at Maesmor [W.J.K.]; at Abergele [J.H.]

BROCKHOLES notes: "Migratory here" in Wirral; "Is occasionally met with in autumn. Sometimes some occur in winter on the sand hills near the Point of Air, Flintshire."

In this last locality, near Talacre, SIR PYERS MOSTYN tells me it is common.

Syrnium aluco. Tawny Owl.

Resident. Often heard in the Eaton Woods, near Chester. Not in Brockholes' list.

In Wales, nests at Padeswood [R.N.] Common at Nerquis Hall, near Mold, where the birds are preserved and regularly fed. Miss Lloyd Fletcher says they will take food in her presence [R.N.] Frequent in the woods, near Colwyn Bay; easily disturbed in the early morning from 3-30 to 4-30 [R.N.] Occurs at Llandyrnog [J.B.] and Abergele [J.H.] and Mr. Ruddy's district.

Athene noctua. Little Owl.

Pennant states that this species is sometimes found in Flintshire (*Brit. Zool.*, *New Ed.*, 1812, vol. i., p. 270.) This is Professor Newton's authority for the same statement in Yarrell (Ed. 4, i., p. 179.)

Mr. R. J. Smith, Aldford, tells me that a small species of Owl, which he believes was the "Little Owl," bred in an oak in the Eaton Park six or seven years ago.

Mr. James F. Lowe about twenty-five years ago had a small Owl, "with a body about the size of a Thrush," given to him by the late Mr. Thyre. It had been caught in a wood near Gresford. It lived for about a year, and was then destroyed by a cat. Mr. Lowe thinks he identified it from Wood's *Natural History* as "Tengmalm's Owl," but allows that it may have been the "Little Owl," which seems more probable, especially as it is said to have been young and unable to fly when first caught.

Scops giu. Scops Owl.

Mention is made in *Yarrell* (Ed. 4, i., p. 174), on the authority of Gould, that a specimen was killed by Mr. J. H. Leche, of Carden Park, Cheshire. Mr. Leche has kindly written to me from Carden Park as follows: "I have the Owl you refer to; it was killed here by my game-keeper (by my direction), I think in 1868. I had it set up by old Mr. Shaw, of Shrewsbury." The date is given as June, 1868, by Mr. Harting (*Handbook of British Birds*, p. 94.)

Order ACCIPITRES.

Circus æruginosus. Marsh Harrier.

There is an immature male of this species in a case of stuffed birds in Mr. Garland's house, which he assures me were all killed on the Eaton Estate, but more than twenty years ago.

Mr. Ruddy tells me that one was killed on Moel Ferna in 1877, and a nest was found on the Berwyns the same year; but the species is now rare. Mr. A. T. Jebb, Ellesmere, mentions having seen it several times near Llansilin.

Sir Pyers Mostyn has an immature specimen at Talacre.

Circus Cyaneus. HEN-HARRIER.

BROCKHOLES says: "In different years, formerly, I have occasionally seen a Harrier. I never obtained one, and did not identify the species for certain. It was probably the above. Bidston Marsh. (Br. p. 4.)

Wales: SIR PYERS MOSTYN has a female specimen at Talacre. MR. W. H. HEATON one (a female) shot at Plas Heaton about 1840; and MR. WYNN one, also a female, obtained at Rûg; while a male, also trapped there, could not be preserved. MR. RUDDY tells me of one being shot on Moel Ferna in 1877; MR. W. KERR, Maesmor, says he has killed one and seen others; MR. A. T. JEBB says he has seen one in the Llansilin district; and MR. R. H. V. KYRKE one on Bodidris Moor in 1891.

The late MR. J. PRICE, in his Guide to Llandudno, says—"the Merlin, Sparrow-Hawk, and *Hen-Harrier* used to be denizens of this part of Wales."

* * **Buteo vulgaris.** COMMON BUZZARD.

BROCKHOLES says: "Seven or eight years ago, one was shot at Puddington. Two others frequented the Dee marshes near there the same autumn, preying on wild fowl." (Br. p. 4.)

In the Grosvenor Museum there is a specimen from Thornton-le-Moors; and another from the Eaton Estate. The latter weighed 2lbs. 9½oz., and had been feeding on rats and skylarks [R.N.] MR. GARLAND has two specimens shot near Eaton.

Not uncommon in the mountainous parts of Flintshire and Denbighshire; one was shot at Bathafarn, near Ruthin, in July, 1871, by MR. A. O. WALKER'S Keeper. One from Moel Fammau is in the Grosvenor Museum. MR. RUDDY states that it is seen in Denbighshire in the winter (and breeds in Merionethshire); and MR. A. T. JEBB mentions two having been caught in traps at Rhiwlas, near Llansilin, one of which is in Ellesmere Museum. MR. WYNN has two in his collection from the Rûg Estate; and SIR PYERS MOSTYN one at Talacre.

Buteo lagopus. ROUGH-LEGGED BUZZARD.

MR. COOKSON has a specimen shot at Oakmere in the summer of 1881. MR. GARLAND trapped one in winter some years ago, near Aldford, using a goose for a bait. It is in his collection at Eaton.

In Wales it occurs occasionally. MR. RUDDY says that in his district it is frequent in winter. The HON. C. H. WYNN, Rûg, has six specimens from his own estate, and thinks it is not much rarer than *Buteo vulgaris.* Has been shot at Nant-y-ffrith [R.H.V.K.] SIR PYERS MOSTYN has one shot at Talacre in 1839. SIR W. WILLIAMS, of Bodelwyddan, tells MR. WALKER that he once shot one at Bodidris.

Aquila chrysaëtus. GOLDEN EAGLE.

MORRIS (*Hist. of Brit. Birds*, vol. i., p. 15), records the occurrence of one near Eaton Hall, previous to 1845. No particulars are given, and as so many reported specimens of the Golden Eagle turn out on investigation to be of the White-tailed species, I think further evidence is necessary before we admit it, without question, as a bird of our district.

* Haliaëtus albicilla. WHITE-TAILED EAGLE.

BROCKHOLES says: "I saw and shot at one, wounding it badly, some years ago, at Leasowe. This bird was afterwards found dead on a neighbouring field."

HIS GRACE THE DUKE OF WESTMINSTER has recently presented to the Grosvenor Museum a fine immature specimen, which was obtained some years ago on the Eaton Estate. It is possibly the one of which a note was inserted in the *Field* (January 31st, 1863, p. 98), and there said to have been shot on January 5th, 1863.

SIR H. B. ROBERTSON has a specimen in the Palé collection, shot on the Berwyns, Merionethshire, near the Denbighshire border, in 1863 [T.R.]

** Accipiter nisus. SPARROW-HAWK.

Common throughout the district. In Wirral "resident and common. This hawk always makes its own nest here. If this be robbed, a second is occasionally built; but generally the second laying of eggs is placed on any old nest which is sufficiently large. If robbed a second time, a third set of eggs is sometimes laid. I once found a third laying of eggs on some leaves which had accumulated in a fork of a tree." (BR. p. 4.)

MR. RUDDY tells me he has taken two sets of eggs from the same nest within a month.

Milvus ictinus. KITE.

A fine specimen was shot at Bruen Stapleford, near Tarvin, by MR. JOSEPH BURGESS, on May 30th, 1892, and is now in his possession at Altrincham.

MR. GARLAND informed MR. NEWSTEAD that an immature specimen was shot in September, 1888, while in the act of eating a Pheasant; it was not preserved. At the same time another was seen by MR. GARLAND, but not shot [R.N.] One was seen at Oakmere in the winter of 1888, by MR. COOKSON.

DR. RUSSELL, Colwyn Bay, says that a Kite was seen there by MR. ELIAS OWEN, who described its forked tail. DR. FRASER, too, who has seen them in Scotland, identified the species at Colwyn Bay [A.O.W.]

[**Elanoides furcatus.** American Swallow-tailed Kite.

A specimen is said to have been shot "on the Mersey" in June, 1843 (*Field*, June 22nd, 1861.) See also Seebohm, *Brit. Birds*, vol. i., p. 64; and Harting, *Handbook of Brit. Birds*, p. 89; also Mitchell, *Birds of Lancashire*, p. 130, where the editor, Mr. Howard Saunders, states that "there is no evidence that the bird was obtained in a wild state, but it may have been brought over in a ship."]

Pernis apivorus. Honey Buzzard.

Mr. Garland has a specimen in his collection at Eaton, shot by himself near Aldford, about twenty years ago.

Mr. Congreve has one in the Burton Collection, dated September 22nd, 1841.

Falco candicans. Greenland Falcon.

Mr. Ruddy writes: "A specimen was picked up dead, and quite fresh, on the Llandbedr Estate, Ruthin, April 1st, 1876," and was reported in the *Field*. Mr. Wynn, Rûg, who has also sent me a note of this specimen, adds that it was probably killed by collision with telegraph wires, and was in the possession of Mr. J. Fairfax Jesse, Bathafarn, Ruthin.

* **Falco peregrinus.** Peregrine Falcon.

The Grosvenor Museum possesses two specimens from Eaton, presented by His Grace the Duke of Westminster; one dated Jan. 16th, 1890, the other Nov. 17th, 1891: both had been feeding on Redwings. Mr. Garland also has a fine male in his collection. Mr. Congreve has a specimen from Burton, dated 1840. It occasionally occurs at Aldford (R.J.S.] and Ince [R.N., Senr.] A curiously marked bird (Coll. G.M.) resembling the Peregrine was shot by Mr. Johnson, farmer, at Ince, Feb. 12th, 1887, possibly an escaped bird of a foreign species. A female was shot by Mr. Lyle Smyth's game-keeper at Barrow, November 25th, 1891 [T.H.]

The late Mr. James F. Robinson, Frodsham, writes in the *Manchester City News* (July 8th, 1882): "I have a fine specimen, a young male in splendid plumage, of the Peregrine Falcon, which was shot two years ago at Manley. For some two or three seasons a pair annually bred in the crags at the summit of Simmond's Hill, Manley, where they were protected by the late Capt. H. Heron, R.N.; since his death they have, through persecution, entirely disappeared from the locality."

In Wales, Mr. Cecil Bradbury found it breeding on the Little Orme's Head in 1891 (Eggs Coll., C.B.) It occasionally occurs in Mr. Ruddy's district. He tells me that a pair nested on the Berwyns in 1875.

The following quotation from PENNANT may be interesting:— "This species breeds in the rocks of Llandudno, in Carnarvonshire. That promontory has been long famed for producing a generous kind, as appears by a letter extant in Gloddaeth Library, from the Lord Treasurer Burleigh to an ancestor of Sir Roger Mostyn, in which his Lordship thanks him for a present of a fine cast of Hawks taken on those rocks, which belong to the family;" and a little further on "their flight is amazingly rapid; one that was reclaimed by a gentleman in the Shire of Angus, a County on the East side of Scotland, eloped from his master, with two heavy bells to each foot, on the Twenty-fourth of September, 1772, and was killed on the morning of the Twenty-sixth, near Mostyn, Flintshire." (Brit. Zool., New Ed. 1812, vol i., p. 220.)

Falco subbuteo. HOBBY.

ORMEROD in his *History of Cheshire* (vol. ii., p. 108), writing of Delamere Forest, quotes from the Harl. MSS., 2115, 232, the "original plea of Richard Done of Utkinton," in which he "claymeth to have all Sparhawks, Marlens, and Hobbys founde within the said forest."

MR. W. COX, Taxidermist, Liverpool, tells me that he has preserved a specimen shot at Oulton Park.

In Wirral "is occasionally obtained in spring (?) and autumn, in Burton and elsewhere." (Br. p. 4.)

MR. RUDDY says that it occasionally occurs in his district in winter; and, on BECKWITH'S authority, that a specimen was killed at Brynkinallt, Chirk, in the autumn of 1880. SIR PYERS MOSTYN has one in the Talacre Collection.

PRICE states that "a Hobby was shot many years ago, near Llanwdden Windmill." (*Llandudno*, p. 104.)

Falco vespertinus. RED-FOOTED FALCON.

MR. RUDDY tells me on BECKWITH'S authority, that one was killed at Wrexham, in May, 1868. (See *Field*, May 23rd, 1868.)

* **Falco æsalon.** MERLIN.

Not uncommon. A male specimen was shot on the Eaton Estate, February 15, 1888, and presented to the Grosvenor Museum by the late LORD ROBERT GROSVENOR.

In Wirral: "migratory, appearing here in spring and autumn. A few remain all winter in the Dee Marshes, occasionally killing the Ring Doves which go there." (Br. p. 4.)

Occasionally during winter in the marshy district of Thornton and Ince [R.N.].

In Wales it breeds on the moors, *e.g.*, at Nant-y-ffrith [R.H.V.K.], Maesmor [W.J.K.], the Berwyns [T.R.]

** **Falco tinnunculus.** Kestrel.

The commonest of our Hawks.

Brockholes states that it is "resident," and adds: "I never knew this kind make a nest. The eggs are laid, in Wirral, on a repaired old nest of the Sparrow-hawk, Crow, Rook, and Magpie. Sometimes also in hollow trees." (Br. p. 4.)

Mr. Ruddy writes: "In the 'Merionethshire slip' this bird breeds regularly; the nest is usually on a ledge of rock, and the eggs placed in a slight hollow on the bare earth; the same spot is resorted to year after year."

Pandion haliaëtus. Osprey.

For a Cheshire record I have to encroach a mile beyond our eastern boundary line, and mention one in the possession of Mr. Hatton (Lord Delamere's head keeper), Vale Royal, which he shot at Petty-Pool, on or about May 20th, 1890.

Williams, in the *History and Antiquities of Aberconwy*, published in 1835, says that "a fine specimen of this bird was shot by the gamekeeper in Gloddaeth Wood, in 1828."

Mr. Stivens has a specimen which was shot when he was Grouse shooting on the Glan-yr-afon Estate, under Moel Fammau, by Mr. Henry Potts' keeper, about fifteen years ago. It had a Trout in its claw.

Mr. Wynn has a beautiful specimen, which was caught in a trap on the moor, near Rûg, in 1880, and preserved by the late Mr. Shaw, of Shrewsbury. Another, killed on the Berwyns about the year 1858, is in the possession of Mr. Vaughan, of Nannau, Dolgelly.

Order STEGANOPODES.

* **Phalacrocorax carbo.** Common Cormorant.

"Not uncommon at times in the Estuary of the Dee, and on the Dee Marshes." (Br. p. 16.)

Visited the Pool at Ashton Hayes in 1893 [G.W.H.] I have seen two (immature), which were shot on Oakmere Lake about fifteen years ago (Coll. Mr. A. Cookson.)

Common all along the Welsh Coast. Breeds on both Orme's Heads [H.T.] On the Little Orme's Head it is double-brooded [A.O.W.]

Mr. Ruddy writes: "It is frequently seen, sometimes two or three together, on the upper waters of the Dee, on fishing expeditions They roost on trees at night."

Phalacrocorax graculus. Shag.

The late Mr. J. Price wrote: "The Crested Cormorant is certainly not uncommon here" (at Llandudno.)

Mr. Stivens tells me he had one from the "Orme"; and Mr. Bradbury says that his friend, Mr. Holmes, shot one on the Conway, about 1890.

* **Sula bassana.** Gannet.

"We had an immature specimen stuffed, which was killed some years ago on the Dee." (Br. p. 16.)

There is one (immature) in Mr. Congreve's collection at Burton. Mr. Townshend Logan tells me he has seen two Gannets flying over Upton, Chester, evidently passing between the Mersey and the Dee.

An adult specimen was found dead on the shore at Abergele by Mr. J. P. Earwaker, April 21, 1892 (Coll. G.M.) One was captured "asleep" at Rhyl, a few years ago [R.N.]

There are two in Sir Pyers Mostyn's collection at Talacre (one adult and one immature.)

Order HERODIONES.

** **Ardea cinerea.** Common Heron.

In Wirral "not uncommon. There was formerly a Heronry at Hooton, which may still exist there. There is a small one at Burton." (Br. p. 11.) This latter has disappeared, but I remember it well in 1867.

An account of its breeding places in Cheshire and North Wales is published in the present volume (p. 234), by Mr. R. Newstead, with many interesting notes on its natural history (p. 226.)

[**Ardea purpurea.** Purple Heron.

A specimen killed on April 7, 1887, near Alderley Edge, Cheshire, but outside the boundary of our district, is now in the collection of Colonel Dixon, of Astle Hall, Chelford. It is noted in the *Zoologist*, November, 1887, xi., 432.]

Ardea ralloides. Squacco Heron.

In the late Mr. J. Price's 'Bewick' the following note occurs, which Dr. Stolterfoth has kindly copied for me:—"One killed near Furnace, on the Conway, July 21, 1828, by Robert Williams, miller; length 1 ft. 10 in., breadth 2 ft. 11 in., now in British Museum. 'Both mandibles yellow' (Bewick.) Note: blue in my specimen; white underneath.'

This occurrence was quoted by the late REV. ROBERT WILLIAMS in *The History and Antiquities of the Town of Aberconwy and its Neighbourhood*, p. 151. He adds that MR. PRICE, then of Bodnod, liberally presented it to the British Museum. Furnace was within a quarter of a mile of Bodnod, or Bodnant, close to the river.

PROFESSOR NEWTON has kindly written to me, saying, "You will find the Squacco Heron included in MR. G. R. GRAY'S catalogue of British Birds in the Collection of the British Museum (1863), p. 148: 'Conway, Denbighshire'; but no donor's name is given, nor is the year of its occurrence."

* Ardetta minuta. LITTLE BITTERN.

On October 24, 1893, a male specimen was shot on the Wallasey Marshes by MR. JAMES GIBSON of Seacombe, and reported in the *Field* (Nov. 18, 1893, p. 791.) It was purchased by subscription for the Grosvenor Museum, where it now is.

"One killed at Talacre about 1836. CAPT. MOSTYN" [F.A.] This is now in SIR PYERS MOSTYN'S Collection.

* Botaurus stellaris. COMMON BITTERN.

Cheshire:—BROCKHOLES says: "I have seen one which was shot in 1857 or 1858 by a farmer as it rose from a pond near Higher Tranmere." (Br. p. 11.)

MR. BYERLEY gives Upton, Bidston Marsh, Hoylake, Irby, &c., as localities. (*Fauna of Liverpool*, 1854, p. 18.)

MR. GARLAND says that formerly it frequently visited the Duck Wood at Eaton; he has a specimen obtained in this locality.

Other records: Two more on the Eaton Estate, over twenty years ago. One between Upton and Greasby in 1892, recorded by MR. C. J. MUDIE, Green Lawn, Rock Ferry, January 28, 1892 [R.N.] One at Tiverton [J.C.S.] One shot on the Race Course, Tarporley, January 25, 1893, by MR. J. RUTTER, who says that he saw another specimen in company with it (Coll. G.M.) One shot at Delamere, about 1887, by MR. A. COOKSON. One shot at Oakmere, about twenty years ago, formerly in collection of the late MR. BURGESS of Winsford [A.C.]

Wales: One near Marchwiel Hall, Wrexham, three or four years ago, shot by MR. PIERCY'S keeper [A.D.] One shot on the shore at Colwyn Bay, about eighteen years ago, for or by MR. ABEL ROBERTS, contractor for the hotel, then building [R.N., on the authority of MR. E. HODKINSON]. One at Coed Coch, thirty or forty years ago [A.O.W.] One killed at Talacre, CAPT. MOSTYN [F.A.] (there are three in the Talacre Collection.) MR. RUDDY writes: "Shot occasionally in the Merionethshire slip; the most recent example on December 22nd, 1890."

Platalea leucorodia. SPOONBILL.

"A specimen was shot about the year 1859, on the Dee Marsh, near Burton." (Br. p. 11.) Possibly this is the same specimen as that noted by JOS. LEYLAND as 'shot at Burton,' 1864; and quoted by H. E. SMITH in *Proc. Hist. Soc. of Lancashire and Cheshire*, Session 1865-6."

Order ANSERES.

[**Anser cinereus.** GREY LAG-GOOSE.

I can obtain no certain record; those I have heard of have proved to be the Bean or Pink-footed species.]

Anser albifrons. WHITE-FRONTED GOOSE.

"Occasionally in winter on the Dee Marshes." (Br. p. 13.)

MR. R. NEWSTEAD tells me he saw one in the flesh which had been shot on the Mersey, off Ince, during the winter of 1885; and MR. R. NEWSTEAD, Senr., saw another (also in the flesh), which had been shot by MR. HYSLOP, gamekeeper, at Thornton-le-Moors, on January 29th, 1894.

Anser segetum. THE BEAN GOOSE.

"On January 30th, 1872, I examined a bird of this species which was lately shot on the Dee Marsh, near Burton." (Br. p. 13.)

"Killed at Talacre and the Vale of Clwyd. CAPT. MOSTYN." [F.A.] One in SIR PYERS MOSTYN'S Collection.

* **Anser brachyrhynchus.** PINK-FOOTED GOOSE.

Under the heading "Grey Geese" BROCKHOLES writes—"Flocks occasionally visit the Dee Marshes which are locally called Grey Geese. I have examined only one specimen which proved to be a Bean Goose. Possibly the Grey-lag and Pink-footed Geese may be included in the term." (Br. p. 13.)

I saw a large flock of "Grey Geese" on the marsh opposite Burton Point in the winter of 1892-3. Some of these were killed and proved to be the Pink-footed species. One in Coll. G.M.

In 1893-4 I examined two shot in the same locality, and exposed for sale in Chester, which were also of the same species.

A female was procured at Tattenhall, January, 1891. [Coll. G.M.]

[**Anser indicus.** BAR-HEADED GOOSE.

There is a specimen in MR. CONGREVE'S collection, shot at Burton in 1848.]

Bernicla leucopsis. Bernacle Goose.

Now very rare, if indeed it ever visits us.

"Prior to 1862 this species was very common on the Dee Marshes, now it is very scarce; sometimes a whole winter passes without any being seen." (Br. p. 13.)

Mr. Congreve has one in the Burton Collection; and Sir Pyers Mostyn one at Talacre.

Two were shot by Mr. R. V. Kyrke, near Wrexham, forty years ago [R.H.V.K.]

Going further back, the late Mr. J. Price notes: "Barnacle Geese infested the wheat fields on Llandrillo Bay one severe winter about 1816."

* Bernicla brenta. Brent Goose.

"Sometimes flocks occur on the Dee Marshes in winter." (Br. p. 13.)

On February 7, 1888, Mr. A. O. Walker saw about two hundred on the Dee Marsh; one flock flew over him.

Spec. Coll., G. M. obtained at Burton-in-Wirral (December 24, 1884.)

"Killed at Talacre, Capt. Mostyn." [F.A.]

[Bernicla canadensis. Canada Goose.

"In the autumn of 1864, two of these birds frequented the Dee Marsh below Puddington; firing a long shot at one one day I wounded it badly, but failed to get it. I heard it was secured a day or two afterwards by a neighbouring gamekeeper." (Br. p. 14.)

"Two seen at Llyn Helyg, J. F. B." [F.A.] At Oakmere [A.C.] No doubt all unpinioned birds which had escaped.

Canada Geese often fly over, and sometimes settle at Edge, coming from Cholmondeley or Bolesworth [C.W.D.]]

[Chenalopex ægyptiaca. Egyptian Goose.

"On November 8, 1870, I saw one which had just been shot from a flock of four. When first seen they were with some tame Geese, but were wary, and had all the appearance of really wild birds. Dee Marsh, near Denhall." (Br. p. 14.)

One was shot on the meadows, near Helsby; it passed into the possession of Mr. Taite, of Llandudno. Another seen in company with it was not obtained [W.T.]]

Cygnus musicus. Whooper.

I occasionally hear of them being seen on the Dee Estuary. "A few most years." [W.C.]

Mr. A. O. Walker notes having seen and heard a string of about thirty, between Bagillt and Holywell, on January 12, 1871.

"During the winter of 1870-71, MR. LAWTON, of Denhall Colliery, shot a bird of this species on the Estuary of the Dee." (Br. p. 14.) This was no doubt one of the flock seen by MR. WALKER.

Occasionally in winter at Ince [R.N., Senr.]

Frequents the mountain lakes on the borders of Denbighshire in hard winters [T.R.]

* **Cygnus bewicki.** BEWICK'S SWAN.

"On December 18, 1871, I examined a bird of this species which was shot by MR. LAWTON on the 14th, on the Estuary of the Dee." (Br. p. 14.)

* [**Cygnus olor.** MUTE SWAN.

Not in a wild state.

MR. WOLLEY DOD writes: "Tame Swans driven away by the parents in autumn often get shot, and are reported as 'Wild Swans.' A brood used to fly from here every autumn."]

[**Cygnus atratus.** BLACK SWAN.

"One was caught some years ago on the Dee. This bird is not noticed in YARRELL'S work. There is an account of it in the recent edition of *Montagu's Ornithological Dictionary*. See at the end." (Br. p. 14.)

BROCKHOLES says also, in his introduction: "The Black Swan is perhaps not yet admitted as an indigenous wild bird of Europe, but I believe is fast becoming so." This is no doubt said on MONTAGU'S authority; who means, of course, that so many imported birds have escaped that they are likely to breed and maintain themselves in a wild state.]

* **Tadorna cornuta.** COMMON SHELD-DUCK.

MR. A. O. WALKER, in his diary, notes: "June 25, 1858, Sheld-Duck, with young, on Salisbury Bank" (Estuary of Dee); and "January 30th, 1865, immense flocks at the mouth of the Dee."

BROCKHOLES says: "In summer and early autumn many Shelldrakes bring their young, on the tide, to the Dee Marshes, and return with the tide. They nest occasionally on Hilbre Island, and in suitable places on the Cheshire side of the Estuary of the Dee." (Br. p. 14.) They are still not uncommon there. A nest was found on MR. CONGREVE'S property, Burton, in 1892.

MR. SHARP, Ledsham, writes: "This Duck formerly bred on the Sandhills, near Hoylake. In 1876 I took a nest and ten eggs." (Two Coll. G.M.) "This must have been one of the last occasions of its breeding, as that year the golf links were extended over the ground which they frequented."

Frequently nested on the banks of the Mersey, between Stanlow and Ince, prior to 1873; it does not breed in this locality now, but is very common in the Mersey in autumn and winter. In 1893 a young bird was taken which was unable to fly [R.N.]

Wales: an interesting account of the breeding of this and other species near the Point of Air, is given in the *Liverpool Naturalists' Journal* (August, 1866, p. 35), by the late Mr. H. Ecroyd Smith; and Sir Pyers Mostyn tells me that many pairs still breed annually on his rabbit warren there.

On the Conway (July 2nd, 1893), Mr. Arthur Moore saw an old bird and three young ones, and writes: "there is almost always a small flock sitting on the rocks, at high tide, near the lighthouse, on the Great Orme."

* **Tadorna casarca.** Ruddy Sheld-Duck.

A specimen killed by a dog near Chester (I believe in a pit at Puddington), in March, 1887, is now in the Grosvenor Museum. It may have been an escaped bird.

* [**Aix sponsa.** Summer Duck.

A beautiful specimen was shot near Flint, in January, 1875, and presented by Mr. L. Henry to the Museum Collection. No doubt an escape from confinement. (Several were at one time kept at Talacre.)

There is a female specimen in the collection of Mr. Kemp, which was shot by him at Burton [A.O.W.]]

* **Anas boscas.** Mallard.

"Generally abundant in winter. A few nest in Wirral." (Br. p. 14.) It seems much commoner on the Mersey in winter than on the Dee, and breeds occasionally at Ince [R.N.] Breeds on the Eaton Estate [H.G.] At Edge Hall a pair or two generally breed in the trees, but I never look for their nests [C.W.D.] Breeds at Combermere [Lord C.]; near Wrexham [A.D.]; Nant-y-ffrith [R.H.V.K.]; Llandyrnog [J.B.]; Maesmor [W.J.K.]; Rûg [C.H.W.]; Llanderfel [T.R.]; Abergele [J.H.,] &c.

Anas strepera. Gadwall.

"Has been shot some years ago on the Dee." (Br. p. 14.)

Mr. Congreve, Burton, has a specimen in his collection, labelled March 13th, 1845; possibly the one Brockholes refers to.

"Killed at Talacre, Capt. Mostyn" [F.A.] (Coll. Sir Pyers Mostyn)

* **Spatula clypeata.** SHOVELER.

Not uncommon on the Eaton Estate in winter. The Grosvenor Museum Collection possesses three specimens, male, female, and immature male; all shot by MR. GARLAND.

"A flock occurs occasionally in winter on ponds, as well as on the Dee Marshes" (Br. p. 14.)

"Killed at Talacre, CAPT. MOSTYN" [F.A.] Three in Coll. SIR PYERS MOSTYN.

* **Dafila acuta.** PINTAIL DUCK.

"Occasionally in winter on the Dee and marshes. In the winter of 1868-69, I shot a fine old male as it rose from a fresh-water pond near Ness." (Br. p. 14.)

MR. R. NEWSTEAD says he has seen very many specimens during the last seven years which have been shot on the Dee.

SIR PYERS MOSTYN has specimens in the Talacre Collection.

Many occurred in January, 1891. One shot at Burton Rocks was procured for the Museum collection.

A young male was shot at Eaton on December 27th, 1890, and presented to the Museum by His Grace the Duke of Westminster.

* **Querquedula crecca.** TEAL.

"Common in autumn and winter; a few nest in Wirral." (Br. p. 14.)

Common on the Mersey in Winter [R.N.]

Breeds on the Eaton estate [H.G.], also in Wales at Rûg [C.H.W.]; and MR. RUDDY'S district; and occurs generally throughout the district in winter in suitable places.

Querquedula circia. GARGANEY.

"I have seen one which was shot some years ago on the Estuary of the Dee." (Br. p. 14.)

There is one in the collection of Mr. Kemp at Burton, which he shot in that district [A.O.W.]

These may possibly be the same birds.

* **Mareca penelope.** WIGEON.

"Abundant in winter on the Dee Marshes. I have known two instances of the Wigeon nesting and rearing young at Puddington. On July 20th, 1863, I shot a Wigeon at Puddington, close to where some young ones were reared in the spring; this bird was very fat and very lousey." (Br. p. 14.)

Common in the Mersey in winter [R.N.]

One at Talacre, shot by SIR PYERS MOSTYN.

Noted at Rûg [C.H.W.]; and in MR. RUDDY'S district.

* **Fuligula ferina.** Pochard.

"During the winter of 1869-70 a male bird was brought to me which had just been shot off a pond at Ness." (Br. p. 15.)

Mr. Byerley states, on Webster's authority, that it is "rare, but has been shot near Hoylake in flooded meadows." (*Fauna of Liverpool*, 1854, p. 21.)

"Killed on the Dee" [F.A.] Specimen in Coll. Sir Pyers Mostyn, Talacre.

A specimen [Coll. G.M.] was obtained from Manley by Mr. Nixon.

Observed at Maesmor [W.J.K.]; and in Mr. Ruddy's district.

* **Fuligula cristata.** Tufted Duck.

"Occasionally met with on the Estuary of the Dee. I have seen it on the Dee Marsh, near Puddington." (Br. p. 15.)

Has occurred at Eaton. One, an immature female, was shot by the Duke of Westminster, on December 27, 1890, and presented by His Grace to the Grosvenor Museum.

Killed on the shore near Bagillt [A.O.W.] There are two in the Talacre Collection. Noted at Maesmor [W.J.K.]; and Mr. Ruddy's district. "Two pairs on the upper waters of the Dee, January 29th, 1894." [T.R.]

* **Fuligula marila.** Scaup Duck.

"Is occasionally shot in the Estuary of the Dee." (Br. p. 15.)

The Grosvenor Museum has three specimens, one (immature) from the above-mentioned locality (Nov. 14, 1888); and two, male and female, from the Conway river, shot by Mr. James Clutton, January 1, 1891.

The Warrington Museum has a specimen from Walton Reservoir. Sir Pyers Mostyn has one killed at Talacre.

* **Glangula glaucion.** Golden-eye.

"From what I am told this is sometimes common on the Estuary of the Dee." (Br. p. 15.)

A specimen shot on the River Dee, December 4, 1889, was presented to the Museum Collection by Lord Arthur Grosvenor. Another specimen (female) in the Museum, was shot on Oak Mere, by Mr. Cookson, December, 1893; and a third (male, immature), was brought to me alive, by a man who had caught it in a gutter on the Dee Marsh; I sent it to Mr. Newstead for observation during life.

There is a female in the Talacre Collection

Frequent on the Mersey [R.N.] A specimen in the Warrington Museum was taken at Walton Reservoir.

Noted at Maesmor [W.J.K.]; Rûg [C.H.W.]; and by Mr. Ruddy.

* **Harelda glacialis.** LONG-TAILED DUCK.

"Has been killed on the Estuary of the Dee." (Br. p. 15.)

A female shot near Burton-in-Wirral, December 2, 1886, was exposed for sale in Chester, and purchased for the Museum Collection by MR. A. O. WALKER.

MR. CONGREVE has a specimen in the Burton Hall Collection, dated December, 1839.

[**Cosmonetta histrionica.** HARLEQUIN DUCK.

A specimen was recorded by YARRELL (*Hist. Brit. Birds*, vol. iii., p. 366) as having been shot at Oulton Park. MR. J. H. GURNEY, Junr, has thrown much doubt upon the occurrence (*Rambles of a Naturalist*, p. 267.)]

* **Œdemia nigra.** COMMON SCOTER.

"An abundant Duck at sea off the north of Wirral. It occasionally comes to the Leasowe shore, and is also sometimes storm-driven to land." (Br. p. 15.)

MR. R. NEWSTEAD says he has seen it off Stanlow Point in the Mersey, but it is not very common.

Abundant at sea along the North Wales Coast; common at Colwyn Bay [A.O.W.]; and Abergele [J.H.]

"Killed at Talacre, CAPT. MOSTYN" [F.A.]

* **Mergus merganser.** GOOSANDER.

"Occasionally occurs on the Estuary of the Dee and on the Dee Marshes" (Br. p. 15.)

Higher up the Dee a specimen was shot by MR. T. H. HIGNETT of Chester, half a mile below Saltney Ferry, on January 9th, 1894 [Coll. G.M.]; three others rose from the same spot. Still higher, one was shot at Eaton, December 4, 1889, and presented by LORD ARTHUR GROSVENOR to the Museum Collection; and in the upper waters MR. RUDDY has observed it, but less frequently than the Red-breasted Merganser. He writes that he observed two at Palé on February 5th, 1894. A fine adult male from the same locality (January 21st, 1892) was presented to the Grosvenor Museum Collection by SIR HENRY ROBERTSON.

* **Mergus serrator.** RED-BREASTED MERGANSER.

The Grosvenor Museum contains three specimens from the River Dee, two of which are from Burton-in-Wirral. SIR PYERS MOSTYN has an immature specimen at Talacre.

Not in BROCKHOLES' List.

Observed on the upper Dee by MR. RUDDY, and more frequently than the Goosander.

* **Mergus albellus.** SMEW.

J. SHAW, Shrewsbury, mentions having received Smews from the Dee, near Chester, for preservation, during January, 1861 (*Zoologist*, 1861, vol. xix., p. 7388.)

For the following interesting note I am indebted to MR. R. NEWSTEAD:—"During the severe weather of January, 1891, seven of this very beautiful species were seen on several occasions in the River Dee, in the neighbourhood of Saltney Ferry. Three of them, two males and a female, were shot by MR. T. H. HIGNETT on the 14th, and were presented to the Museum. Subsequently MR. HIGNETT shot another male; this unfortunately dropped on the floating ice, and was probably carried out to sea.

On the 18th I was fortunate in seeing two males swimming near the Chester side of the river, a little beyond the Saltney Ferry. The birds saw me immediately I approached the river bank, and got as near the opposite side as they thought safe, and there remained for twenty minutes, giving me a splendid opportunity of watching their habits. Both birds were in adult plumage; but from the size of its crest and cautious manners one was evidently an old bird; this fellow acted as sentinel while the other continually dived. Eventually the birds took wing, apparently rising with little difficulty; at first they flew towards the city, but gradually wheeled round towards me, flying straight down the centre of the river.

When swimming the neck is much arched, and the bill scarcely extends beyond the breast. During the whole of the time that I watched them the crest was carried semi-erect, and at all times the beautiful greenish-black feathers were conspicuous. The black wing-feathers were hidden by the marginal breast-feathers, which gave the birds a much whiter appearance than I anticipated. The birds uttered no note as they rose from the water; their flight, too, was very silent.

They had evidently resorted to our river for the sake of the Flukes (*Platessa flesus*, FLEM.), which abound, as I found ten of these fish and a Salmon Fry in the gullet of the male which was shot by MR. HIGNETT."

Noted by the late MR. F. ARCHER as "killed at Talacre, CAPT. MOSTYN;" there is a young male in SIR PYERS MOSTYN'S Collection there; also a female (?) in MR. CONGREVE'S Collection at Burton.

Order COLUMBÆ.

* **Columba palumbus.** RING-DOVE OR WOOD-PIGEON.

"An abundant resident." (Br. p. 10.)

MR. NEWSTEAD notes: "I saw immense flocks of these birds in the Eaton Woods, on December 13, 1893, and on inquiry found that they had been there for some time. Probably the greater part of them were migrants, and had undoubtedly been attracted by the excessive crop of acorns. At all times the bird is very common in this district, but I have never seen it in such vast numbers before. (Generally, acorns are very scarce in Cheshire; it is only in exceptional seasons, such as 1893, that there is anything like a crop.)"

Mr. Wolley Dod also writes (from Edge Hall): "The most remarkable feature in birds this autumn and winter, has been the great abundance of Wood Pigeons and Wild Ducks, owing to the large crop of acorns, which always attract them."

Mr G. W. Hayes tells me he once counted sixty-nine acorns of ordinary size in the crop of one which he shot.

* Columba œnas. Stock-Dove.

Brockholes says: "A common resident. This species ordinarily nests in rabbit holes, but I have known it nest in ivy growing on a wall close to the front door of a house. R Barton, Esq., tells me that at Caldy this bird sometimes nests on the ground under bushes of dwarf gorse as well as in rabbit holes." (Br. p. 10.)

Fairly common at Burton, breeding in the forks of big trees [E.T.L.]; and along the Dee shores, breeding in rabbit holes [W.E.S.]; also at Eaton [R.J.S.]; Moston [W.H.D.]; Backford [R.P.B.], nesting in trees. Very common at Edge Hall, breeding in old trees, on the trunk head, or inside it [C.W.D]; not uncommon at Nant-y-ffrith, breeding in rocks, hollow trees, and rabbit burrows [R.H.V.K.]. At Maesmor common but local, breeds regularly in hollows between the branches of old lime trees, and in deep holes in the sand [W.J.K.] Common and general in Mr. Ruddy's district, breeding in rabbit burrows and hollow trees. Breeds in the Warrens at Talacre [Sir P.M.] (see also *Liverpool Nat. Journal*, Aug., 1866.) Occurs at Abergele [J.H.]; Colwyn Bay, but is not common [A.O.W.]

I am puzzled about the Doves which I am told breed on the Orme's Heads; I think they are probably of this species, but possibly the Rock Dove may also be there.

[Columba livia. Rock-Dove

No certain record that I can discover.]

* Turtur communis. Turtle-Dove.

In Wirral "a common summer visitor to Ness, Burton, and Puddington; I think also to the adjacent neighbourhood." (Br. p. 10.)

Common in some seasons at Burton [E.T.L.] Not observed at Ledsham [W.E.S.] Not uncommon about Chester, and seems to be increasing; is frequently seen on the Dee Cop [S.C.] Breeds at Backford, eggs taken June 18, 1889 [R.P.B.]; and occasionally at Saighton and Eaton [R.J.S.] I have eggs taken at Saighton more than twenty years ago.

At Ince not very common [R.N.] At Combermere, common [LORD C.] At Edge Hall, "very common; having become so within twenty years." [C.W.D.]

At Nant-y-ffrith, frequents certain spots, but is not common [R.V.K.] In the upper Dee valley, common [W.J.K.] Tolerably plentiful in the Vale of Clwyd and at Glyn Ceiriog; was very rare twenty years ago [T.R.] Common at Colwyn Bay [A O.W.]; fairly so at Abergele [T.H.]

Order PTEROCLETES.

Syrrhaptes paradoxus. PALLAS'S SAND-GROUSE.

[Irruption of 1859. No example recorded in our district, though I may mention that one of the first five killed in Europe was obtained from Tremadoc, on July 9 of that year, by MR. CHAFFERS: an adult male (Coll. Derby Museum, Liverpool.)]

Irruption of 1863: "On May 29 or 30, two were seen at Hoylake; one of these was obtained in fine plumage, and presented to the Derby Museum, Liverpool. Communicated by MR. T. J. MOORE, keeper of the Derby Museum." (Br. p. 10.) The label on this specimen adds MR. LITTLER's name to the notice.

On November 20 of the same year the late MR. MOORE sent a further note to the *Zoologist* (1864, v. xxii., p. 8889), viz.: "Sand-Grouse in Cheshire. A fine male specimen of Pallas' Sand-Grouse (*S. paradoxus*) was shot early in the month near Leasowe Castle, by MR. SIMPKINS, of Chester Street, Birkenhead."

[In 1872 and 1876 none recorded here that I know of.]

Irruption of 1888. The late MR. MOORE recorded "Nine seen May 27." (*Field*, June 16, 1888, p. 854.) MR. NEWSTEAD knows of three specimens shot near Storeton: one, a fine adult female, on June 1, presented to the Liverpool Museum by SIR THOMAS BROCKLEBANK; the other two in the possession of MR. GEORGE SHEREWOOD.

Order GALLINÆ.

* Tetrao tetrix. BLACK GROUSE.

MR. STIVENS tells me that he remembers well sporting for Black-cock and Grey-hen, about thirty years ago, in Delamere Forest, before its cultivation. He used to shoot four or five brace in a day.

MR. R. H. VENABLES KYRKE writes: "The Black Grouse thirty years ago was common in parts of Denbighshire and Flintshire, but now it is nearly, if not quite extinct. In Flintshire, I believe the last Grey-hen was accidentally shot about twenty years ago, at Nant-y-ffrith. A strong Black-cock, most likely from Montgomeryshire, was seen last spring near Llandegla."

A Grey-hen was shot by Mr. L. Ledsham, Junr., in his garden at Green Lane, Boughton, Chester, on November 21, 1892, and presented to the Grosvenor Museum.

* **Lagopus scoticus.** Red Grouse.

Mr. Byerley mentions: "One shot at West Kirby a year ago by Mr. Robins." "A pair once in Claughton Fir-wood" (*Fauna of Liverpool.*)

Mr. Stivens thinks there may be a few on the Bickerton Hills.

On the Flintshire and Denbighshire moors they are abundant.

A very dark specimen from Moel Fammau was presented to the Grosvenor Museum by Colonel B. G. Davies Cooke.

Phasianus colchicus. Pheasant.

Preserved in all suitable localities.

Sir Pyers Mostyn, in the Talacre Collection, has a hybrid between a cock Pheasant and a domestic Fowl.

Perdix cinerea. Common Partridge.

Generally distributed.

After the land in Delamere Forest was reclaimed, and the Black Grouse were driven away, Partridges became very abundant [J.C.S.]

One or two specimens have recently occurred with the white "horse shoe." [R.N.]

Caccabis rufa. Red-legged Partridge.

One was shot at Bagillt by Mr. Pierce, October 1, 1892 (*Field.*)

One was shot at Frodsham [G.W.H.] One on Sealand [W.T.]

* **Coturnix communis.** Quail.

Brockholes notes it as "a scarce summer visitor to Leasowe, Bidston, Rock Ferry, Bebington, Ness, and Burton" (Br. p. 10.) The same may be said with regard to the district generally, in many parts of which it seems to be unknown.

Mr. T. H. Hignett says that some years ago Quail were frequently killed on Sealand.

A nest taken on Mr. Leather's farm, Delamere, in 1870, was reported in the *Field* (vol. 37, Jan. 14, 1871, p. 20) by Mr. W. D. Fox.

Mr. Wolley Dod, Edge Hall, writes: "I heard it close to my house in 1868, when they were abundant all over the country."

It occasionally occurs in Denbighshire, where it was noted in 1866 [W.H.H.], and where several pairs nested in 1871 [T.R.]

MR. STIVENS, in his beautiful collection, has a case of six Quails which were shot by the late DR. MCEWEN and himself out of a bevy of eight or ten, at Nannerch, about twenty years ago.

Fairly common about Holywell and Caerwys some years [A.O.W.] Heard twice near Holywell [A. DICK.] SIR PYERS MOSTYN tells me that he has frequently seen bevies at Axton, in the parish of Llanasa.

The late MR. J. PRICE writes: "Quails visited the Eglwys Fach district *irregularly* in my time. I have *heard* them, I believe, in the low ground by Prestatyn."

Last year (1893) they were again abundant throughout the country, including our district. They were frequently heard in the fields adjoining the Dee cop [S.C., H.D.]; and were reported also from Saughall [T.A.B.]; and Aldford [R.J.S.] In Wales several were killed at Bodidris, having bred there [R.H.V.K.]; and others in the neighbourhood of Wrexham [R.H.V.K.] Near Holt, MAJOR LEADBETTER, early in September, shot five out of a bevy of eight, the young birds having been hatched in an adjoining quarry. MR. BARNARD himself shot seven at Llandyrnog. They were also shot at Denbigh [*Field*]; Rhyl [Spec. Coll. G.M.]; and Maesmor [W.K.] MR. BATES, of Gyrn Castle, shot one at Axton [SIR P.M.]

"About twenty years ago a Quail was shot in the court-yard of Nant-y-ffrith by MR. R. V. KYRKE, on New Year's Day." [R.H.V.K.]

Order FULICARIÆ.

** Crex pratensis. LAND RAIL.

A common summer visitor; usually first heard about the beginning of May. In 1892 a female was picked up under the telegraph wires at Helsby, on April 7. It had been feeding on beetles.

"A summer visitor; sometimes common." (Br. p. 13.)

* Porzana maruetta. SPOTTED CRAKE.

Occasionally met with in autumn.

"One was picked up dead some years ago by a labourer, at the end of summer or beginning of autumn, under the telegraph wires on the Neston and Chester road, near Ness." (Br. p. 13.)

One was shot at Great Sutton in a turnip field, by the late REV. E. A PITCAIRN CAMPBELL, of Vicar's Cross, on October 13, 1888 [Coll. G.M.] Another was killed a few days afterwards in the Upton Nurseries [Coll. G.M.]

A male was picked up at Hoole, Chester, on September 11, 1889, the stomach of which was found by MR. NEWSTEAD to contain quartz, pebbles, and three or four skins of Lepidopterous larvæ [Coll. W.H.D.]

Odd specimens have occurred at Burton [W.C.]; "the marshy districts of Thornton-le-Moors, Ince, and Helsby" [R.N.]; Aldford [R.J.S.]; Nant-y-ffrith [R.H.V.K.]; Maesmor [W.K.]; Mold [A. Dick]; and Talacre [F.A.]

* **Rallus aquaticus.** Water-Rail.

"In some parts of Wirral this bird is not uncommon in winter." (Br. p. 13.) The same may be said of most parts of the district.

Noted at The Dale, near Chester [H.D.]; Burton [W.C.]; Ledsham [W.E.S.]; Aldford [R.J.S.]; Ince (common in winter) [R.N., Senr.]; Edge [C.W.D.]; Nant-y-ffrith [R.H.V.K.]; Maesmor [W.J.K.]; Rûg [C.H.W.]; Bathafarn [A.O.W.]; Colwyn Bay [A.O.W., R.N.] [Coll. G.M.]; Abergele [J.H.]; Talacre [Sir P.M.]

Common in winter on the upper Dee [T.R.]

* **Gallinula chloropus.** Moor-Hen.

In Wirral, "an abundant resident." (Br. p. 13.) Also throughout the district in all suitable places.

* **Fulica atra.** Coot.

In Wirral "an occasional winter visitor. I saw one on March 24, 1871, near Ness, but think it did not remain" (Br. p. 13.) A pair or two every year in the pits near Ledsham, but always killed or frightened away [W.E.S.] Mrs. Longueville remembers them frequenting some ponds on rather swampy ground below Grange Hill, near West Kirby, as long as eighty years ago.

"Scarce now" at Aldford [R.J.S.] "Once seen" at Ince [R.N., Senr.] Very common at Combermere [Lord C.] At Edge Hall "a pair or two often begin to breed, but are generally driven away by the Swans." [C.W.D.] Common near Wrexham [A.D.] "A pair seen breeding in Wynnstay Park, May 25, 1892." [T.R., on Beckwith's authority.] Common in winter in Mr. Ruddy's district. Common near Colwyn Bay in suitable localities. Breeds at Fawnog [A.O.W.]; and regularly at Talacre [Sir P.M.]

Common, in hard weather, near the mouth of the Dee, below Saltney [T.H.H.]; one shot there in 1892 [Coll. G.M.] Mr. Ashwin notes it as "very common on the shore in winter"; probably he refers to Llanerchymor, near Holywell, where a stream runs into the Dee [A.O.W.] Price noted it "one winter *about* 1821 on the Afon Ganol, and *flying out to sea.*"

Order LIMICOLÆ.

Œdicnemus scolopax. Stone Curlew.

There is a specimen in the Warrington Museum, labelled "Hoole, Chester." It was obtained from Mr. Frank Nicholson, Manchester, who purchased it from a bird stuffer in Chester, probably the late Mr. Wm. Thompson; Mr. Hutchinson, who succeeded Mr. Thompson, says he remembers it distinctly.

[Cursorius gallicus. CREAM-COLOURED COURSER.

The occurrence of a specimen in "North Wales," in 1793, is recorded by FLEMING (*Hist. Brit. An.*, p. 112), and quoted by MONTAGU, HOWARD SAUNDERS, SEEBOHM, and HARTING.]

Eudromias morinellus. DOTTEREL.

"Has been shot on the shore a few years ago, near Denhall. It is scarce." (Br. p. 10.)

One was shot by MR. HARRISON, New Pale, Frodsham, May 2, 1887.

The late MR. J. PRICE notes: "One seen at Cerig-y-druidion in my father's time."

*** Ægialitis hiaticula.** RINGED PLOVER.

In Wirral, "resident round the shores. Numbers also arrive in autumn to stay the winter, or go further south." (Br. p. 11.)

Found breeding at the Point of Air by MR. ECROYD SMITH in 1866 (*Liv. Nat. Journal*, Aug., 1866, p. 35); and by MR. W. E. SHARP on the Middle Island, Hilbre, in 1876.

Common along the Coast of Wales. At the mouth of the Conway [A.M.]

*** Charadrius pluvialis.** GOLDEN PLOVER.

In Wirral, "A common winter visitor. Sometimes there are many on the Sealands and Dee Marshes." (Br. p. 10.) There were several in the fields near Saughall Station during the cold weather of November, 1893, and I have seen them in the fields near Upton, Chester. Also it occurs on the Welsh Coast, *e.g.*, at Colwyn Bay [W.B.R.]; but MR. A. O. WALKER does not consider it at all common on the coasts of Flint and Denbighshire

Not very common at Ince, Helsby, and Thornton-le-Moors [R.N.] At Combermere sometimes in winter [LORD C.]

Breeds on the hills near Minera [R.H.V.K.]; also on the Denbighshire side of the Berwyns, and at Llangwm, near Corwen [T.R.]

*** Squatarola helvetica.** GREY PLOVER.

"A few occur every winter in the Estuary of the Dee. I have seen large flocks of this, or the Golden Plover, on the shore near the Point of Air, Flintshire, and flying thence towards Mostyn. I think the flocks I have often seen there keep more to the shore than Golden Plovers generally do." (Br. p. 11.)

In the autumn of 1887 a number were exposed for sale in Chester, which were shot on the Wirral side of the Dee Marsh.

Scarce at Ince [R.N., Senr.] In September, 1887, one was obtained at Colwyn Bay by Mr. Porter [Coll. G.M.] Noted at Abergele [J.H.]

Frequently shot at Talacre [Sir P.M.]

Vanellus vulgaris. Lapwing.

In Wirral, "An abundant resident" (Br. p. 11.) Breeds throughout the district, and assembles in large flocks in winter.

* Strepsilas interpres. Turnstone.

"Scarce on the shores of Wirral. Has formerly been shot near Denhall." (Br. p. 11.)

An immature specimen was obtained from Hoylake, 1893 [Coll. G.M.] Two were shot at the mouth of the Dee, August 31, 1892, by Dr. Herbert Dobie, who saw many others at the same time [Coll. G.M.] Mr. E. T. Logan has seen them about Heswall and Gayton.

One was shot "on the mud below Glanconway Station, about 1824," by the late Mr. J. Price.

** Hæmatopus ostralegus. Oyster-catcher.

"Abundant on the shores," of Wirral, "in autumn and winter. I have good authority for stating that it has been known to nest near Hoylake." (Br. p. 11.)

Occasionally in winter on the shores of the Mersey, at Stanlow and Ince, but scarce [R.N.]

Breeds near the Point of Air [Sir P.M.]

Common along the Welsh coast. Mr. Arthur Moore notes: "Common on the Conway shore. I have seen a flock of fully a hundred on the rocks, at high tide, near the lighthouse on the Great Orme."

* Phalaropus fulicarius. Grey Phalarope.

"Occasional in winter on the marshes and in the Estuary of the Dee." (Br. p. 13,)

In September, 1866, the month of an irruption of this species in the South of England, the late Mr. Moore recorded "a specimen . . . . . immature, shot on Bidston Hill, by Mr. John Williams, of Claughton, Cheshire." (*Liv. Nat. Jour.*, Oct., 1867, p. 173.)

One "seen at Leasowe, October 6th, 1874," was reported by Mr. A. J. Clark Kennedy, Leasowe Castle, in the *Zoologist* (1874, vol. ix., 2nd series, p. 4239.)

A number of specimens were obtained on the coast and inland in October, 1891, viz, one at Queen's Ferry, October 17th

[Coll G.M,]; this bird weighed only 9 drachms 50 grains, but the plumage was in good condition; stomach contained remains of *Coleoptera*, chiefly *Aphodius punctato-sulcatus*, and a bright green species like *Phratora* [R.N.] One at Connah's Quay, shot by MR. T. BITHELL [Coll. MR. R. P. BRADBURY.] One at Northwich, shot by MR. W. H. HICKSON, Dunham Hill [R N.]; and two others in North Wales—exact locality not ascertained. [R.N.]

A specimen in summer plumage was shot at Wallasey, early in August, 1893, by MR ROBINSON, a wildfowler. I purchased it from MR. COX, Taxidermist, Liverpool [Coll. G.M]

MR. RUDDY says this species is frequently seen on the Dee in autumn, from Llangollen upwards to Bala

* **Phalaropus hyperboreus.** RED-NECKED PHALAROPE.

A specimen [Coll. G.M.] preserved by the late MR. WILLIAM THOMPSON, formed part of the old collection of local birds, which numbered six or eight in all.

MR. BYERLEY notes: "One specimen from a pit in Cheshire," on the authority of MATHER, Taxidermist (*Fauna of Liverpool*, p. 20.)

Scolopax rusticola. WOODCOCK.

In Wirral, "More or less common in winter. During the spring of 1860, three or four pairs of Woodcocks frequented woods near Birkenhead until an advanced date. In the evening of August 24th, 1856, I saw a Woodcock between Bidston and Upton. I have also seen a Woodcock in one or two other instances in summer I therefore think there is little doubt that this species occasionally breeds in Wirral although I have no authentic instance of a nest." (Br. p. 12.)

MR CONGREVE writes from Burton: "Not very common. A good many may sometimes be found, but I don't think they stay long." Scarce at Ince [R.N.] At Eaton the number varies in different years: few in 1892, many in 1893 [H.G.]

Delamere Forest was formerly noted for Woodcock [J.C.S.]; they are now common there, arriving in November [A.C.] LORD COMBERMERE writes December 16th, 1893, "I saw seven yesterday."

At Edge "very uncertain. Mostly arrive in the last week of October, but snow or frost sometimes brings them at Christmas." [C.W.D.]

Nant-y-ffrith, much scarcer than formerly [R.H.V.K.] Common at Llandyrnog, arriving early in October [J.B.] Some every year at Maesmor [W.K.] Common in MR. RUDDY's district in the winter months; he has seen one on April 11th. MR. J. HANNAH and his friend saw one either in May or the beginning of June in swampy ground in a wood, suggesting the possibility of breeding there; and COL. B. G. DAVIES COOKE informed MR. R. NEWSTEAD that a few years ago he found three unfledged young near Cilcain, Mold.

Colwyn Bay, not very common [A.O.W.]

Gallinago major. GREAT SNIPE.

"Two shot near Chester" were reported by "Tribune" in the *Field*, vol. xi., p. 81, January 23rd, 1858.

One is said to have been shot on the site of the present Railway Station, Chester, by the late MR. E. C. WALKER [A.O.W.]

MR. BYERLEY notes it "Twice at Upton," near Birkenhead, "also several times at Hoylake." *(Fauna of Liverpool.)*

One was shot at Stanlow Point, Ince, by CAPT. PARK YATES' keeper some years ago.

Another was shot in the meadows by the Gowey, near Barrowmore, in the winter of 1889 [G.L.S.]

Another at Maesmor on September 8th, 1870 (*Field.*)

PRICE notes one at Moel Cyffylog, above Eglwysfach.

** Gallinago cœlestis. COMMON SNIPE.

In Wirral, "More or less common in autumn or winter. From having sometimes seen snipes in July and August, I judge a few breed in Wirral, although I have no authentic instance of a nest." (Br. p. 12.)

Common in one place on the Dee Marsh [W.C.] Near Chester I have seen them rise in large flocks from the Bache Pool before it was drained. Seen in the Mollington meadows in July [H.D.]

It breeds annually in the meadows near Aldford [H.G.]; and in the marshes near Frodsham, Helsby, and Thornton-le-Moors [R.N.] Breeds at Oakmere [A.C.] Scarcer every year at Edge Hall [C.W.D.]; also much scarcer than formerly at Nant-y-ffrith [R.V.K.] MR L. J. DOBIE found a nest at Rosset. Breeds at Llandyrnog [J.B.]; Maesmor [W.J.K.]; Rûg [C.H.W.]; MR. RUDDY'S district; near Colwyn Bay, on the moorland towards Tafarn Newydd [W.B.R.]; Llansannan, near Abergele [J.H.]; and no doubt many other localities.

* Gallinago gallinula. JACK SNIPE.

"Until 1863, this was an abundant winter visitor" to Wirral. "I have seen much fewer since that date." (Br. p. 12.)

Common in one place only on the Dee Marsh [W.C.] Common in winter at Maesmor [W.J.K.]; and in MR. RUDDY'S district.

On the whole is much less common than the preceding species throughout the district, and is getting scarcer.

* Tringa alpina. Dunlin.

Brockholes notes: "Abundant round the shores in autumn and winter. A few breed in suitable places in Wirral. In the spring of the year 1871, I received eleven eggs which were taken by a boy on the Dee marshes near Puddington and Shotwick." (Br. p. 12) This means at least *three* nests, as the Dunlin always lays four eggs. There is no evidence of its breeding there now.

Occurs in large flocks in autumn and winter all along the coast.

Mr. Ruddy says he has seen it in grouse shooting time in the mountains, when migrating. Mr. W. J. Kerr thinks it may breed in one locality, but the fact is not established.

The late Mr. J. Price says: "I saw Dunlin at Llyn Aled in the breeding time, about 1874."

* Tringa minuta. Little Stint.

"Scarce on the shores" of Wirral "in autumn and winter." (Br. p. 12.)

There is one in Mr. Congreve's Collection, date 1838.

Dr. Herbert Dobie came across a flock of a dozen or more at the mouth of the Dee, on September 1st, 1892, and shot three specimens for our local collections [Two Coll. G.M.]

A dead specimen was found on the road between Llandudno and Deganwy, a few years ago [H.T.]

Tringa temmincki. Temminck's Stint.

"On August 25th, 1862, I met with two of this species; one of these I shot. Dee Marsh, near Shotwick." (Br. p. 12)

This specimen would probably belong to Flintshire.

* Tringa subarquata. Curlew-Sandpiper.

"Not uncommon in autumn especially amongst Dunlins. Dee Marshes." (Br. p. 12.)

I have occasionally found them amongst strings of Dunlins from the above locality, in the Chester shops.

Of frequent occurrence on the Mersey also [R.N.]

One shot on the shore at New Brighton, January, 1891 [W.B.]

Tringa striata. Purple Sandpiper.

Brockholes says: "I have seen a specimen which was shot about the year 1866 on the shore near Parkgate." (Br. p. 13.)

The late Mr. Price notes having seen them twice in small flocks (very tame) previous to 1824; once by Penmaen Caves, and once at Rhos Farm; and each time in a heavy gale from the north.

Two or three specimens were shot in the autumn, 1893, at Moreton, and stuffed by MR. W. COX, Liverpool [Coll. J. WRIGLEY, ESQ., Formby.]

* **Tringa canutus.** KNOT.

"Abundant in autumn and winter in the estuary of the Dee." (Br. p. 12.)

Frequent in winter on the Mersey [R.N.] Occurs along the Welsh coast. Common near the Point of Air [SIR P.M.] The Grosvenor Museum has a series obtained from Bagillt by MR. A. O. WALKER and MR. R. NEWSTEAD. Two shot at Pensarn, December, 1893 [J.H.]

* **Calidris arenaria.** SANDERLING.

"Common in autumn on the Dee Marshes." (Br. p. 11.) This is still the case [H.D.]

"A few frequent the Leasowe shore in winter." [Br.] Occasionally on the Mersey [R.N.]

A specimen was obtained from Connah's Quay, November 3rd, 1885 [A.O.W.]; and one by MR. HANNAH, Abergele, on the Pensarn shore, November 24, 1888 [Coll. G.M.]

Inland, a male in spring plumage was shot at Tarporley, about May 20, 1887.

* **Machetes pugnax.** RUFF

"Several Ruffs were shot in spring some years ago in the Estuary of the Dee. A few young Reeves occur almost every autumn on the Dee Marshes." (Br. p. 12.)

MR. CONGREVE has a Reeve in his collection, shot at Burton.

An immature specimen was shot at the mouth of the Dee, in 1880 [Coll. G.M.]; the late MR. WM. THOMPSON, who preserved it, said he not infrequently received them in the autumn.

MR. GARLAND has a fine specimen of a Ruff, in summer plumage, in a case of birds which were obtained on the Eaton Estate, over twenty years ago.

A Ruff in the Warrington Museum is labelled "Frodsham Marsh, 1889."

** **Totanus hypoleucus.** COMMON SANDPIPER.

"A not uncommon visitor" to Wirral. "Much less frequent than formerly." (Br. p. 12.) Still found at Burton [W.C.]

Breeds on the marshes of Thorton-le-Moors, Ince, and Helsby; but is scarce. [R.N.]

Breeds annually at Oakmere. A male, female, and three young in down, from a nest near the margin of the mere, were presented to the Grosvenor Museum by MR. A. COOKSON.

Not uncommon in the Dee above Chester, and sometimes below at Saltney. Common higher up the Dee at Llangollen; breeds at the "World's End" [R.N.]; and in the Ceiriog valley; also in MR. RUDDY'S district. Fairly common at Colwyn Bay [A.O.W.], Abergele [J.H.], Talacre [Sir P.M.], and Flint [F.A.]

The way in which this bird will feign lameness is well known. MR. RUDDY once saw it feign death: he suddenly came upon a sitting bird, which, to his surprise, dropped its head on the side of its nest and stretched out its wings, allowing itself to be picked up by the hand.

Totanus macularius. SPOTTED SANDPIPER.

In the Warrington Museum there is a specimen of this American species which was shot (with either one or two others) by MR. EDWIN LORD from the banks of the Mersey, near Fiddler's Ferry, in May, 1863. It was formerly in the collection of MR. C. S. GREGSON, and MR. GREENING tells me that his (MR. GREENING'S) father saw it in the flesh. Concerning this record MR. SEEBOHM says (*British Birds*, vol. iii., p. 123) that the evidence in support of it remains unshaken; and MR. GURNEY considers it as one of the six most deserving of credence out of twenty-six recorded occurrences in Britain (*Rambles of a Naturalist*, p. 262). I do not know on which bank of the Mersey it was shot, but from the narrowness of the river at this point, it may fairly be claimed by both Cheshire and Lancashire.

* **Totanus ochropus.** GREEN SANDPIPER.

An autumn and winter visitor, not very uncommon.

MR. BROCKHOLES states: "About half a dozen occur every autumn at Puddington and neighbouring parts of the Dee Marshes. I have also seen an occasional one in ponds at Ness in autumn." I shot one on the canal meadows, near Chester, in the autumn of 1883 (?) [Coll. G.M.]; and MR. RALPH CONGREVE gave me a specimen shot by him on the Dee Marsh in September, 1891.

MR. HUGH LYLE SMYTH shot one at Barrowmore Hall on January 4th, 1890 [Coll. G.M.]; and MR. E. T. LOGAN one at Aldersey. MR. HUGH ALDERSEY writes, February 5th, 1894: "We have had a Green Sandpiper here all winter that has become almost tame." Occasionally at Edge, by ponds, in September [C.W.D.]

In Wales: MR. W. J. KERR has observed it several times in autumn at Maesmor; and MR. RUDDY tells me that it occurs frequently during the winter, from September to March, on the Dee, from Llangollen upwards.

** Totanus calidris. COMMON REDSHANK.

"Common round the shores" of Wirral "in autumn and winter." (Br. p. 11.) The same may be said of the Ince district [R.N., Senr.]; and the mouth of the Conway [A.M.]

It breeds in one place near the Dee in Wirral; and also, MR. NEWSTEAD tells me, on the "wild marshes" at Thornton-le-Moors.

It occurs in winter along the Welsh Coast, *e.g.*, at Rhyl [W.J.K.]; Pensarn [J.H.]; Colwyn Bay, &c.

I have no note of it from inland parts of the district.

[Totanus fuscus. SPOTTED REDSHANK.

BROCKHOLES states: "A bird was killed about the year 1864, which from description was most probably referable to this species. Dee Marsh, near Burton." (Br. p. 11.)]

* Totanus canescens. GREENSHANK.

"Occasionally in autumn and winter on the Dee Marshes." (Br. p. 12.)

MR. RALPH CONGREVE and MR. MALCOLM LOGAN shot three out of a flock on the marsh at Burton, on August 29th, 1891. [One Coll. G.M.]

* Limosa lapponica. BAR-TAILED GODWIT.

"Sometimes common in autumn on the Dee Marshes." (Br. p. 12.) In the autumn of 1892 there were large flocks on these marshes [D.D., H.D., E.C.D.], from which DR. HERBERT DOBIE shot specimens for the Grosvenor Museum, and our private collection. I shot one at West Kirby on December 11th, 1886; it had previously been wounded in the leg, which perhaps accounted for its late stay.

Specimens have been frequently brought to the Museum from the Dee Marshes. I have not seen specimens from the Mersey [R.N.]

DR. WHITE, Warrington, tells me he saw a pair as far up the Mersey as Arpley.

Limosa belgica. BLACK-TAILED GODWIT.

In the autumn of 1891 (?), MR. RALPH CONGREVE shot a specimen on the Dee Marsh, near Burton, at a time when numbers of Golden Plovers and some Greenshanks were about [Coll. MR. W. CONGREVE.]

Some years ago I saw one in the hands of the late MR. WM. THOMPSON for preservation, which had been shot on the Estuary of the Dee.

* **Numenius arquata.** CURLEW.

BROCKHOLES' remark that it is "common in autumn and winter round the shores" (Br. p. 11) applies to the whole district as well as to Wirral. It breeds freely on the moors and mountains of Wales, *e.g.*, Moelfre-Uchaf [R.K.C.]

In the Minera district these birds generally lay their eggs on a bare piece of ground which has been "fired." [R.N.]

Numenius Phœopus. WHIMBREL.

"Occasional in autumn and winter round the shores. Sometimes a flock may be seen." (Br. p. 11.)

Apparently scarce. I have not been able to obtain a specimen for the Museum Collection [R.N.] There is one in the Warrington Museum "from Runcorn, presented 1852."

MR. CECIL SMITH, Blacon Point, has obtained for me the information that MR. LUNT (the keeper) often sees them in early spring in the fields of Sealand (Flintshire), and sometimes on the Cheshire side of the county boundary. He shot a specimen, which I have seen stuffed in his house.

Order GAVIÆ.

* **Hydrochelidon nigra.** BLACK TERN.

BROCKHOLES says: "I have seen one in autumn on the Dee Marsh near Puddington." (Br. p. 16.)

The late MR. WM. THOMPSON told me that one year he received several specimens from the Dee Estuary.

Two specimens were shot at Oakmere on April 22nd, 1893, but one only was obtained; it proved to be a male in mature summer plumage [Coll. G.M.] MR. NEWSTEAD found the stomach to contain chiefly *Diptera* (a large species), also two wing-cases of a bright green *Chrysomelid* beetle, and one specimen of *Aphodius punctato-sulcatus*. (This was reported in the *Zoologist*, June, 1893, p. 227.)

Sterna fluviatilis. COMMON TERN.

"Sometimes occurs in autumn on the Dee and Marshes. I have seen it also on Bidston Marsh. I believe this species formerly bred in Wirral." (Br. p. 16.)

"I have seen odd specimens from the Dee, chiefly immature" [R.N.]

Occasionally at Ince, along the bank of the Mersey [R.N.]

"Very numerous along the banks of the mouth of the Conway; also seen on the shore beneath the Great Orme, on the Conway Bay side." [H.T.]

Occasionally inland along the upper Dee [T.R.]

** [**Sterna macrura.** ARCTIC TERN.

No doubt this species, as well as the preceding, occurs at the mouths of our rivers and along the Welsh coast in autumn. I am unable to say which is more abundant. Of several specimens sent me from Anglesea in 1891, the two were about equally represented. At the Skerries (Anglesea) the present species was by far the more numerous in the breeding season 1893.]

** **Sterna minuta.** LITTLE TERN.

"An autumn visitor to the Dee Marshes." (Br. p. 16.)

Common at the mouth of the Dee [A.O.W.]

MR. H. ECROYD SMITH found it breeding, in company with the Ringed Plover, at the Point of Air (*Liv. Nat. Jour.*, August, 1866, p. 38.) SIR PYERS MOSTYN tells me it still breeds there.

Xema sabinii. SABINE'S GULL.

An immature specimen was shot at Mostyn during the last week of October, 1884, by MR. JOHN WILLIAMS. He watched it in a field adjoining the shore for some hours before he was able to obtain a shot. It was preserved by the late MR. WM. THOMPSON and added to the private collection of MR. WALLACE, of Chester, who kindly allowed me to send it for exhibition at a meeting of the Zoological Society of London on Feb. 2nd, 1886. (See *Zoologist*, March 1886, p. 118.)

Larus minutus. LITTLE GULL.

DR. BELL, New Brighton, has a specimen shot off the coast, near the New Brighton Fort, on November 1st, 1880.

"Several specimens were shot about 1869, on the Wild Marsh, Queensferry." [W.T., in diary A.O.W.]

MR. BYERLEY mentions "one killed near New Ferry." (*Fauna of Liverpool*, p. 23.)

* **Larus ridibundus.** BLACK-HEADED GULL.

"A few may be seen on the Dee Marshes nearly all the year. Some must nest not far off." (Br. p. 16.)

This is the commonest Gull seen in our fields in the winter, often feeding amongst flocks of Peewits. It regularly visits the Roodeye, Chester. Sometimes it becomes very tame; in the hard weather of 1892-3 I watched several within a few feet of a window in the Chester Infirmary feeding on the scraps thrown out to them.

It is abundant on the coast, and follows up the rivers far inland.

Amongst a flock congregated about the Woodside Landing Stage, Birkenhead, on February 17th, this year (1894), several had already assumed their brown hoods.

In Cheshire it breeds certainly in one spot in Delamere Forest [L.G.]

In Denbighshire, MR. R. H. VENABLES KYRKE tells me that it breeds in the neighbourhood of Nant-y-ffrith.

In Flintshire its nest was found on the Sandhills, near the Point of Air, about the year 1870, by SIR PYERS MOSTYN, who put the bird up off her nest and took the two eggs, which he has presented to the Grosvenor Museum.

In the Merionethshire slip, the history of the establishment of a colony near Palé, must be related in MR. RUDDY'S own words :—

"Two pairs of this species nested for the first time in 1888, on a small moorland lake near Llanderfel, nine miles from Corwen. Tiny islands were formed by the recent enlargement of the lake, and on these the birds found a safe retreat, the margin of the lake being very boggy and difficult of approach. Ten pairs nested there the following year, and they were more than doubled in 1890; there was quite a large colony there in 1893. I once observed them mobbing a heron; they met it on its way to the lake, kept darting at it and screaming loudly until they drove it off. They also met me on my approach to the lake, and with continual loud screams darted at me from a considerable height, until within a couple of yards from me; then would sweep up again with a graceful curve so as to renew the attack."

The great variety in shape, size, and colour of the eggs of this species is well known. I selected a few clutches to illustrate this from a colony on a small island in Lough Corrib, co. Galway, where I chanced to stop for lunch while fishing, on June 23rd, 1892. In one nest were three eggs of a pale bluish green colour, absolutely devoid of markings; in another, a similar egg was laid, together with two of a usual type.

* **Larus canus.** COMMON GULL.

Common on our shores in autumn and winter, and frequently seen inland in rough weather.

"Very common round the shores" of Wirral, "except in the nesting season." (Br. p. 6.)

It is far from common at Colwyn Bay [A.O.W.]

The statement in WILLIAMS' list (1835), copied by PRICE in his "Guide to Llandudno," that this species bred on the rocks of Llandudno and Rhiwleden, must be erroneous.

* **Larus argentatus.** HERRING GULL.

A common species on our coasts and estuaries, and often seen inland in winter. By far the commonest species at Colwyn Bay [A.O.W.]

"Is common round the shores" of Wirral, "except in the breeding season." (Br. p. 16.)

It breeds on the Great and Little Orme [Eggs Coll. G.M. and MR. C. BRADBURY.]

Larus fuscus. LESSER BLACK-BACKED GULL.

Common, but less general than the Herring Gull.

Commoner than that species at Ince [R.N.]

"Is common round the shores" of Wirral, "except in the breeding season." (Br. p. 16.)

Probably breeds on the Little Orme [C.B.]

Occasionally seen on the Upper Dee above Llangollen [T.R.]

* **Larus marinus.** GREAT BLACK-BACKED GULL.

Not uncommon on our coasts.

About nine came to Colwyn Bay during the gale of November 18th and 19th, 1893 [W.B.R.]

"Occurs occasionally on the Dee. Is more frequent on the north shore of Wirral." (Br. p. 16.) A specimen obtained at Parkgate, January 9th, 1889, was presented to the Grosvenor Museum by MR. J. L. DENSON.

MR. NEWSTEAD says he has frequently seen it on the Mersey, near Ince; but nearly always singly.

A fine adult was shot at Frodsham, January 13th, 1894 [T.H.]

MR. RUDDY says that a pair which he had in the gardens at Palé were voracious feeders. They would eat mice, rats, live eels, trout, small pike, &c., always swallowing them whole, and casting up the bones as clean as if polished.

* **Rissa tridactyla.** KITTIWAKE GULL.

Common upon our shores and estuaries. (Spec. from Rhyl, Coll. G.M.) Breeds on the Little Orme's Head. (Eggs, Coll. MR. C. BRADBURY.)

"Very common round the shores of Wirral, except in the nesting season." (Br. p. 16.)

MR. R. P. BRADBURY has a specimen from the Dee above Chester.

[Stercorarius catarrhactes. GREAT SKUA.

"I have seen a Skua which was most probably this species—New Ferry." (Br. p. 16.)]

* Stercorarius pomatorhinus. POMATORHINE SKUA.

An immature specimen was shot at Queensferry, on the Dee Estuary, on October 20th, 1890, by MR. MEALING, Chester. (Coll. G.M.)

MR. BYERLEY mentions one shot at Hoylake, September, 1852, by MR. H. CRUMP. (*Fauna of Liverpool.*)

I have seen an immature bird belonging to MR. ALWOOD, Bruera, which is of this species. It was shot by his son, MR. ROBERT ALWOOD, about fourteen years ago, who says there were two together, feeding on a decomposed rabbit.

Stercorarius crepidatus.
ARCTIC OR RICHARDSON'S SKUA.

A Richardson's Skua is mentioned by MR. H. DURNFORD, 1, Stanley Road, Waterloo, as shot on the Cheshire coast about September 22nd, 1872: "remarkable for its dark plumage; a bird of the year." (*Zoologist*, vol. vii., 1872, 2nd series.) [T.A C.]

* Stercorarius parasiticus.
LONG-TAILED OR BUFFON'S SKUA.

A specimen (immature) was shot by MR. R. H. VENABLES KYRKE, at Forydd, near Rhyl, in 1869, and presented by him to the Grosvenor Museum.

Order PYGOPODES.

* Alca torda. RAZOR-BILL.

Common off our coasts. Breeds in the Great and Little Orme [H.T., C.B.] (Eggs Coll. C.B.)

"Is occasionally met with in the Estuary of the Dee" (Br. p. 15.)

One was obtained at Atherton's Quay, on the Mersey, February 20th, 1882 (Coll. Warrington Museum.)

A specimen blown inland by the gale of January 27th, 1894, was caught in a garden in Chester, and brought to me alive.

* **Uria troile.** COMMON GUILLEMOT.

Common off the North Wales coast.

Breeds on both Great and Little Orme [H.T., C.B.] (Eggs Coll. G.M.)

"Is sometimes met with on the Estuary of the Dee." (Br. p. 15.)

A fine specimen of the "Ringed" variety, in summer plumage, was taken alive by a fisherman in the River Mersey, at Ince, in 1882 [Coll. G.M.] There is one from Frodsham in the Warrington Museum, presented 1851.

Uria grylle. BLACK GUILLEMOT.

PENNANT says: "We have seen it on the rocks of Llandudno, in Caernarvonshire." (*British Zoology*, New Ed., 1812, vol. ii., p. 164.)

The late MR. J. PRICE, in his "Guide to Llandudno" (no date), says: "The Black Guillemot or Tyste used to breed regularly at the west end of the Little Orme's-head."

* **Mergulus alle.** LITTLE AUK.

"Some years ago, I saw one in rough weather in winter on the Mersey. I have since seen one which was killed near Hoylake." (Br. p. 15.)

A specimen was shot while on the wing during a heavy gale at Manley by MR. W. WRIGHT. [Coll. G.M.]

They have been picked up dead on the shore at Pensarn [J.H.] and Llandudno [H.T.]

** **Fratercula arctica.** PUFFIN.

As this species has now returned in some numbers to its old breeding ground at Priestholme, or Puffin Island, off the coast of Anglesea, it is probable that more will be seen off our coast than formerly.

Occasionally they are blown inland in rough weather. One was picked up alive on the Eaton Estate in the winter of 1885-6 (Coll. Mr. J. C. STIVENS), and another was found in a wood at Crabwall Hall on October 27th, 1893, and lived for two days with ducks in a pond. (Coll. MR. JOHN DAVIES.) Both were birds of the year.

Family COLYMBIDÆ.

Colymbus glacialis. GREAT NORTHERN DIVER.

MR. F. NICHOLSON (*Manchester City News*, October 9th, 1875), states that A. CLARKE KENNEDY, on April 9th, 1868, while at Leasowe Castle, saw a Great Northern Diver opposite Hilbre Island, swimming leisurely in the shallow water about 200 yards from the shore [T.A.C.]

An immature bird was killed at Oakmere, six or seven years ago [Coll. MR. COOKSON.] One was shot at Cuddington in 1887 [A.O.W.]

MR. A. O. WALKER and I watched some large Divers through a glass at the Llandrillo Weir, on December 28th, 1893, which we believe were of this species.

Colymbus arcticus. BLACK-THROATED DIVER.

MR. J. BUSHBY, Formby, in the *Field* (vol. 49, January 27th, 1877), mentions shooting a Black-throated Diver at the mouth of the Dee, about a month before the date of writing, and hearing of another being shot the week before [T.A.C.]

* **Colymbus septentrionalis.** RED-THROATED DIVER.

"Concluding with the year 1860, this species was common in winter in the lake at Hoylake. I have not been there since, nor have I seen a living specimen since." (Br. p. 15.)

There is a specimen in the Grosvenor Museum from the Dee Estuary, in summer plumage, presented by MR. A. O. WALKER (date unknown); and I have a specimen with a good deal of red in its throat, which was caught in a fishing net near Flint, November 22nd, 1886. Two were shot by MR. BUCKLEY HOLMES off the Point of Air, in September, 1888; one of the birds had the red throat, the other was immature [R.N.]

Not uncommon on the North Wales coast at Colwyn Bay [A.O.W.]

There is one in the Warrington Museum from "near Warrington Bridge," January 31st, 1849.

Family PODICIPEDIDÆ.

* **Podicipes cristatus.** GREAT CRESTED GREBE.

"Has been shot on the Estuary of the Dee. I believe this bird still breeds on some of the Cheshire meres." (Br. p. 15.)

I have made inquiries about this latter point, and LORD COMBERMERE has kindly answered that "there are several nests every year" at Combermere Lake. MR. COOKSON, of Oakmere, says that both large and small Grebes occur there, and breed regularly at Oulton Park. It nests also, I believe, at Cholmondeley, and (MR. GREENING informs me) on Walton Reservoir, near Warrington. It also breeds on other Cheshire Meres east of our district [T.A.C.]

A specimen was shot at Eaton in 1886 by MR. GARLAND, the DUKE OF WESTMINSTER's head keeper. [Coll. G.M.]

It has occurred at Maesmor [W.J.K.]

It occasionally visits Abergele [J.H.] and the bay of Llandudno in the winter [H.T.] I shot one (a female) from the shore near Colwyn Bay, on December 28th, 1893. [Coll. G.M.] SIR PYERS MOSTYN has a specimen at Talacre.

Podicipes griseigena. RED-NECKED GREBE.

"Is occasionally obtained on the Estuary of the Dee." (Br. p. 15.)

Podicipes auritus. SLAVONIAN OR HORNED GREBE.

MR. CONGREVE has a specimen in his collection which is labelled "Burton, January, 1839."

Podicipes nigricollis.

BLACK-NECKED OR EARED GREBE.

A Grebe of this species was killed on a small pond near the railway at Bagillt, on September 27th, 1856. The specimen has unfortunately been destroyed; but it was recorded in the *Zoologist*, and MR. A. O. WALKER took great pains to identify it.

MR. BYERLEY mentions "a stuffed specimen at Oxton, which had been shot upon the Mersey shore near Tranmere" (*Fauna of Liverpool*, p. 22.)

Podicipes fluviatilis. LITTLE GREBE.

The Dabchick is fairly common and generally distributed throughout the district. It may sometimes be seen on the Dee at Chester in winter.

It bred at Backford in 1889 [R.P.B.]; and for several seasons on a sheet of water close to Meolse Station, near Hoylake [W.E.S.]

It frequently breeds in the Ince and Thornton-le-Moors district, and near Tarporley [R.N.] Also at Oulton Park [A.C.]; occasionally at Aldford [R.T.S.]; Rowton [Life History, Coll. G.M.]; and no doubt in many other places. It was observed by the late MR. BECKWITH in Wynnstay Park, on May 27th, 1892 [T.R.]

It is common in winter in MR. RUDDY's district, where he has observed it diving in the Dee, and remaining under water for twelve seconds; and occurs at Maesmor [W.J.K.]

BROCKHOLES remarks: "some years ago I met with this species every winter in ponds and streams in the north of Wirral. I have not seen one in Wirral for ten or twelve years."

Order TUBINARES.

Fulmarus glacialis. FULMAR.

MR. BYERLEY notes its occurrence "at Wallasey, 1854, in stormy weather during the spring." (*Fauna of Liverpool.*)

* **Puffinus anglorum.** MANX SHEARWATER.

I examined one which was shot at Saltney, Sept. 1st, 1887. (Coll. MR. SHORE, Chester.)

One was found dead at Upton, near Chester, Sept. 1st, 1892; and another three days later (Sept. 4, 1892) was taken alive in a goods shed belonging to the L. & N. W. Railway at Chester. [Both in Coll. G.M.]

MR. STIVENS has a specimen killed at Llandudno.

* **Cymochorea leucorrhoa.** FORK-TAILED PETREL.

A specimen was found dead in the city of Chester, near the Northgate Station, on Dec. 8th, 1886. [Coll. G.M.]

Another was shot on the Dee, near Queensferry, by Mr. J. CLUTTON, the Leadworks, Chester, Jan. 10th, 1887. [Coll. G.M.]

A third was taken alive in an exhausted condition in the Eccleston Meadows, October 10th, 1892. [Coll. G.M.]

A fourth, from Talacre, is in SIR PYERS MOSTYN's collection.

Procellaria pelagica. STORM PETREL.

BROCKHOLES remarks: "A fresh specimen was found dead a few years ago on the Dee Marsh, near Puddington, and given to me immediately afterwards. In several instances I have seen a specimen of this Petrel flying on the Mersey, between Woodside and the Landing Stage at Liverpool." (Br. p. 16.)

Several shot at New Brighton in the winter of 1880-81 [W.B.] Has been observed at Ince [R.N., Senr.]

"Dee Light Vessel, November 10th, 1885: one Storm Petrel struck." [MESSRS. WORK & CLAGUE] (Migration Committee Report, 1885, p. 116.)

MR. WYNN has a specimen found dead in a turnip field at Plas Adda Farm, near Rûg, in 1870, about thirty miles from the nearest sea coast.

Number of Species considered to have occurred in a wild state within the boundaries of the District	223
Number of Species [bracketed] considered to be of doubtful occurrence, or to have been obtained beyond the District Boundary, or not to have occurred in a wild state	16
Total	239

LIST OF AUTHORITIES REFERRED TO BY INITIALS PLACED WITHIN BRACKETS.

F.A. ....The late Mr. F. Archer, Crosby.

J.B. ....Mr. J. Barnard, Gamekeeper, Llandyrnog, near Denbigh.
T.A.B. ......Mr. T. A. Beckett, Saughall.
W.B. ......Mr. W. Bell, New Brighton.
R.P.B. ......Mr. R. P. Bradbury, Chester.
C.B. ....Mr. Cecil Bradbury, Chester.

R.K.C. ....Mr. R. K. Cardew, St. Minver, East Lyss; formerly Llandulas.
Lord C. ....Lord Combermere, Combermere Abbey.
W.C. ......Mr. W. Congreve, Burton Hall, Cheshire.
A.C. ....Mr. A. Cookson, Gamekeeper, Oakmere.
T.A.C. ......Mr. T. A. Coward, Bowdon.
S.C. ....Mr. Sidney Cummings, Chester.

A.D. ....Mr. Alfred Darby, Wrexham.
A. Dick ....Mr. A. Dick, 47, Belsize Park, London.
W.M.D. ....Dr. William M. Dobie, Chester.
W.H.D. ....Mr. W. Henry Dobie, Chester.
D.D. ....Mr. Douglas Dobie, Chester.
L.J.D. ......Mr. Leonard J. Dobie, Heswall; formerly Llandulas and Rosset.
H.D. ....Dr. Herbert Dobie, Chester.
E.C.D. ......Mr. E. Cyril Dobie, Chester.
C.W.D. ....Rev. C. Wolley-Dod, Edge Hall, Malpas.

H.G. ....Mr. H. Garland, Gamekeeper, Eaton Park, Chester.
L.G. ....Mr. Linnæus Greening, Warrington.

J.H. ....Mr. J. Hannah, Abergele.
G.W.H. ....Mr. George W. Hayes, Ashton Hayes.
W.H.H. ....Mr. W. H. Heaton, Reigate; formerly Plas Heaton, near Denbigh.
T.H. ....Mr. T. Hutchinson, Taxidermist, Chester.

W.K. ......Mr. W. Kerr, Maesmor, near Corwen.
W.J.K. ....Mr. W. J. Kerr, Trelydan Hall, Welshpool; formerly Maesmor.
R.V.K. ....Mr. R. V. Kyrke, Pen-y-wern.
R.H.V.K. ..Mr. R. H. Venables Kyrke, Nant-y-ffrith.

E T.L. ......Mr. E. Townshend Logan, Upton, Chester.

A M. ......Mr. Arthur Moore, Roe Wen, Conway.
Sir P.M. ....Sir Pyers Mostyn, Talacre.

R.N. Sen. ..Mr. R. Newstead, Ince.
R.N. ......Mr. R. Newstead, Grosvenor Museum, Chester.
A.J.N. ......Mr. A. J. Nixon, Birdham School, Chichester; formerly Manley.

T.S.P. ......Mr. T. S. Parry Chester.
J.P. ....The late Mr. John Price, Chester.

T.R.........Mr. Thomas Ruddy, The Gardens, Palé, near Corwen.
W.B.R. ....Mr. W. B. Russell, Colwyn Bay.

W.E.S. ....Mr. W. E. Sharp, Ledsham.
R.J.S. ......Mr. R. J. Smith, Aldford.
G.L.S. ......Mr. Godfrey Lyle Smyth, Barrowmore.
J.C.S. ......Mr. J. C. Stivens, Chester.

H.T.........Mr. Harry Thomas, Llandudno.
W.T. ......The late Mr. William Thompson, Taxidermist, Chester.

A.O.W. ....Mr. A. O. Walker, Nant-y-Glyn, Colwyn Bay.
A.P.W. ....Mr. A. P. White, Little Budworth.
E.C.W. ....Mr. E. C. Williams, formerly Nannerch.
C.H.W. ....The Hon. C. H. Wynn, Rûg, near Corwen.

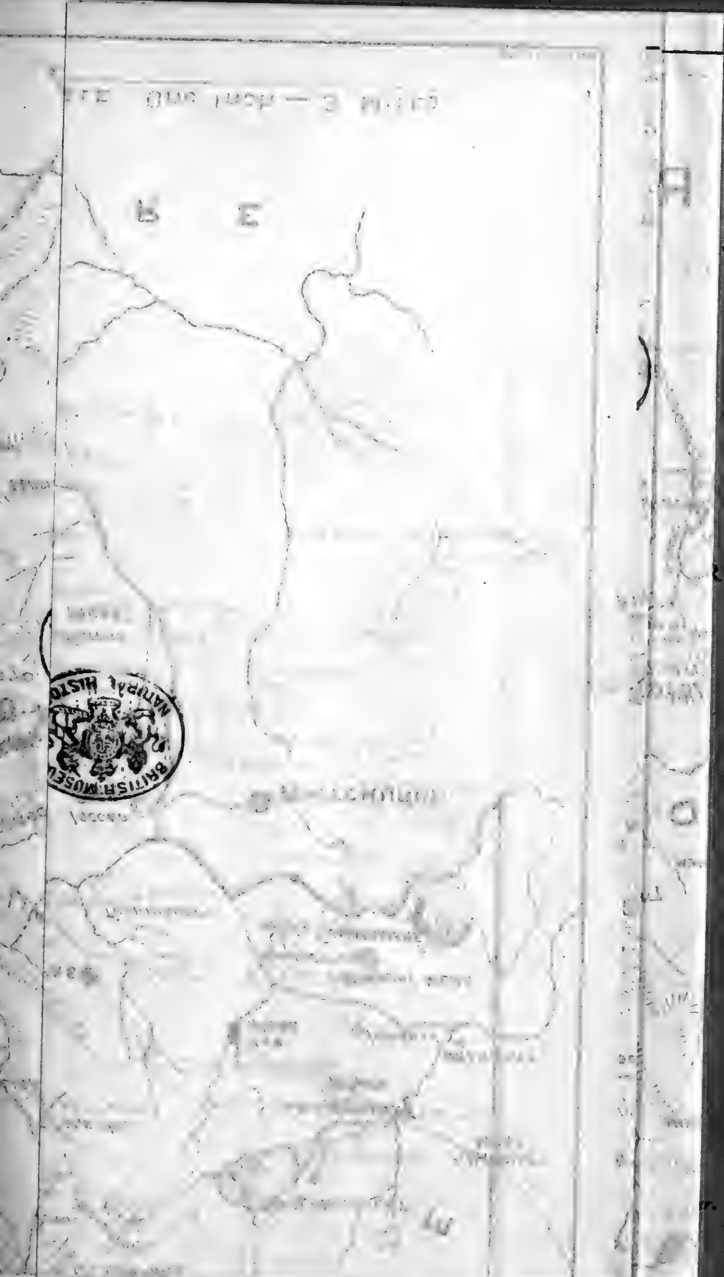
NOTE.

A Map has been inserted, on which most of the places mentioned in the List are marked, rendering unnecessary a separate Table as proposed on page 285.

ERRATA.

Page 304, line 14.—For "to store them up," read "to be stored up."

Page 342, line 18.—For "still breeds there," read "bred there a few years ago, and may do so still."



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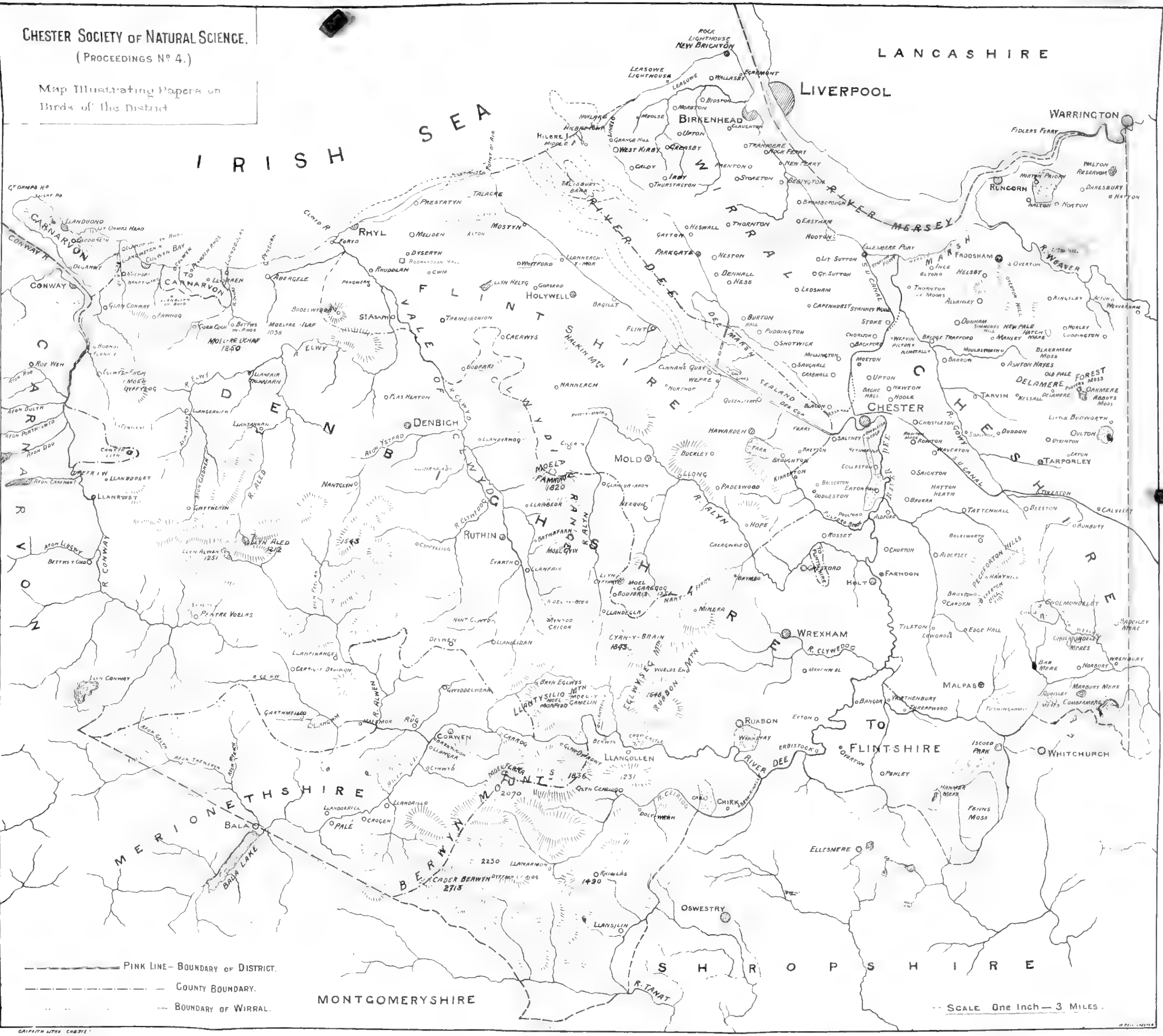
CHESTER SOCIETY OF NATURAL SCIENCE.
(PROCEEDINGS Nº 4.)
Map Illustrating Papers on Birds of the District
IRISH SEA
LANCASHIRE
LIVERPOOL
BIRKENHEAD
NEW BRIGHTON
WARRINGTON
RUNCORN
FRODSHAM
RIVER MERSEY
R. WEAVER
WIRRAL
RIVER DEE
CHESTER
CHESHIRE
DELAMERE FOREST
TARPORLEY
MALPAS
WHITCHURCH
FLINTSHIRE
HOLYWELL
FLINT
MOLD
HAWARDEN
WREXHAM
RUABON
LLANGOLLEN
CHIRK
OSWESTRY
ELLESMERE
TO FLINTSHIRE
DENBIGHSHIRE
DENBIGH
RUTHIN
RHYL
ST ASAPH
ABERGELE
CONWAY
LLANDUDNO
CARNARVON
CARNARVONSHIRE
VALE OF CLWYD
CLWYDIAN RANGE
MOEL FAMMAU 1820
CORWEN
BALA
BALA LAKE
MERIONETHSHIRE
BERWYN MOUNTS
CADER BERWYN 2713
SHROPSHIRE
MONTGOMERYSHIRE
R. TANAT
PINK LINE — BOUNDARY OF DISTRICT.
COUNTY BOUNDARY.
BOUNDARY OF WIRRAL.
SCALE One Inch — 3 MILES.
GRIFFITH LITHO CHESTER

PROCEEDINGS

OF THE

Chester Society of Natural Science, Literature, & Art.

A LIST

OF

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CARNARVONSHIRE, AND ANGLESEA,

COMPILED AND EDITED BY

GEORGE O. DAY, F.E.S.,

WITH THE ASSISTANCE OF

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No. V.

Copies may be obtained from the Curator, Grosvenor Museum, Chester.

[Price 2/6].

1903.

G. R. GRIFFITH, PRINTER, GROSVENOR STREET, CHESTER.

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1903.

PREFACE.

THE following list is based upon that of MR. ALFRED O. WALKER, F.L.S., published in 1885 in the Proceedings of the Chester Society of Natural Science. The district covered, however, has been extended so as to include the whole of Cheshire and the Counties of Flint, Denbigh, Carnarvon, and Anglesea. The total area is 2,878 square miles, the length (from east to west) being about 120 miles, and the average breadth about 24 miles. The physical geography is very diversified. In the extreme east, on the borders of Derbyshire and Yorkshire, we have hills of considerable altitude, reaching 1,834 feet at "Shining Tor" in the high-lying country between Buxton and Macclesfield. Proceeding westward the country slopes downward to the plain of Cheshire, which forms the greater part of the county, with a few outcropping hills as at Alderley Edge, Helsby, Peckforton, Beeston, and Broxton. Nearing Wales the land again rises, and attains the height of 1,820 feet at Moel Fammau in Flintshire. From this point, westward, the country is more or less mountainous, with the intervening valleys of the Clwyd and Conway, until Anglesea is reached, when the surface again becomes comparatively flat. In Cheshire the New Red Sandstone formation predominates, overlaid with soils of clayey and sandy loams. In Flintshire and Denbighshire there is an isolated ridge of carboniferous limestone, with its attendant peculiar *flora* and *fauna*. This formation again appears, to a small extent, near Penmaenmawr. The mountains of Carnarvonshire consist of, chiefly, the Upper and Lower Silurian Rocks, and are of majestic proportions; they are disposed in the wildest manner, and often rise to a height of over 3,000 feet. Such peaks are mostly bare of vegetation, excepting occasional heather and short grass; but the *flora* of the lower slopes and valleys is of varied character, and often accompanied by rare Lepidoptera.

With the exception of Cheshire, some parts of Flintshire, the coast-line, and the valleys of Llangollen, Clwyd, and Conway, the district appears to have been very inadequately worked by lepidopterists. Reports are greatly needed for the country round Snowdon, and for the Isle of Anglesea; and in the following pages the absence of records from Anglesea must not be taken as evidence that the insects do not occur in that County.

A large proportion of the area under review is cultivated. The localities most productive of lepidopterous *fauna* are the coast sandhills, the mountain sides, the "mosses" (principally in Cheshire), and the few tracts of woodland, such as Delamere Forest, Dunham Park, Tatton Park, &c.

Although much work remains still to be done, especially in Wales, a considerable amount has been accomplished, and many additional species have been recorded, since MR. WALKER'S list was published. A revision and extension of that list was therefore thought desirable, and the following pages are the result. We may mention, incidentally, that the introduction of electric lighting has been the means of attracting several species not hitherto known to occur in the district, besides showing the more frequent occurrence of others previously considered rare.

The nomenclature and arrangement of genera have been changed from those of MR. WALKER'S list, and have been brought more into accordance with recent publications. The classification and names adopted are those of Staudinger and Rebel's Catalogue of 1901, which, though open to objections, may, we think, be followed with advantage until a more acceptable list is forthcoming.

It was intended to include the remaining genera of the Micro-lepidoptera; but, while records for Cheshire are fairly numerous, those for North Wales are at present so meagre, that it was thought advisable to defer dealing with them until more information should be available. It is a matter for regret that so little attention has been paid, especially in North Wales, to this branch of Lepidoptera.

We have drawn liberally on DR. J. W. ELLIS'S publication, *The Lepidopterous Fauna of Lancashire and Cheshire*, for records of Cheshire insects, and gratefully acknowledge our indebtedness to this source. Our thanks are also due to MR. CHARLES OLDHAM, who has extracted a number of interesting records from early volumes of *The Zoologist;* and to the following Entomologists, who have been good enough to furnish us with the records resulting from their work in the district:—

	Abbreviated.
MR. J. ARKLE, Chester	A.
MR. FRED. BIRCH, Liverpool	B.
MAJOR F. T. BLAND (in the *Entomologist*) ..	Bl.
LORD BOSTON (by favour of Mr. C. G. Barrett) ..	Ld. B.

	Abbreviated.
MR. A. D. PITCAIRN-CAMPBELL, Vicar's Cross, near Chester	P.C.
MR. JOSEPH COLLINS, Warrington	Co.
MR. B. H. CRABTREE, F.E.S., Levenshulme ..	Cr.
MR. G. O. DAY, F.E.S., Knutsford .. .	Da.
DR. HERBERT DOBIE, Chester	Do.
COLONEL FREWIN, Tarvin Sands	F.
MR. WILLOUGHBY GARDNER, F.L.S., F.E.S., &c., Deganwy	W.G.
MR. NOAH GREENING, *the late* (records in Cheshire within 12 miles of Warrington)	N.G.
MR. A. HARRISON, F.E.S., London	H.
MR. CHAS. F. JOHNSON, Stockport	J.
MR. THOS. G. MASON, Lytham	M.
MR. ROBT. NEWSTEAD, A.L.S., F.E.S., &c., Chester	N.
THE MISSES PERKINS, Rhyl	Pe.
MR. G. T. PORRITT, F.E.S., Huddersfield ..	Po.
MR. H. B. PRINCE, Birkenhead	Pr.
MR. W. E. SHARP, Hanwell	Sh.
MR. J. HENRY STOCK, M.P., the White Hall, near Tarporley	Stk.
REV. C. S. STUBBS, M.A., Carrington Vicarage ..	Stb.
MR. ROBT. TAIT, Junr., Crumpsall	Ta.
REV. C. F. THORNEWILL, Calverhall Vicarage, Whitchurch	Th.
MR. JOHN THORPE, Altrincham	Tp.
REV. C. WOLLEY-DOD, Edge, near Malpas ..	C.W.D.
MR. F. H. WOLLEY-DOD, Edge, near Malpas ..	F.H.W.D.

The publications quoted are—

MR. A. O. WALKER'S List	*W.L.*
DR. ELLIS'S *Lepidoptera of Lancashire and Cheshire*	*E.L.*
The Entomologists' Monthly Magazine	*E.M.M.*
The Entomologist	*Ent.*
The Entomologists' Record	*Ent. Rec.*

Other abbreviations employed are—

Ang.—Anglesea
C.—Cheshire
Car.—Carnarvonshire
D.—Denbighshire
F.—Flintshire
a.—Abundant
c.—Common
f.c.—Fairly common
m.c.—Moderately common
e.l.—Electric light
l.—Larva
n.—Not
o.—Occasional
p.—Plentiful
r.—Rare
s.—Scarce
sp.—Sparingly
u.—Uncommon
v.—Very

In this Introduction we have touched, necessarily very briefly, on the general features of the district. Further information as to the Geology, Climate, &c., will be found in the following publications:—

BIBLIOGRAPHY OF THE GEOLOGY AND METEOROLOGY OF THE DISTRICT.

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Professor T. McKenny Hughes; Proceedings Chester Society Natural Science, No. 4, pp. 263-265 (1894).

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A. C. Ramsey; Proceedings Geological Society; read March 26th, 1851.

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A. O. Walker; *l.c.*, pp. 86-92.

Colwyn Bay—Spring and Summer of 1893 at.
A. O. Walker; Proceedings Chester Society Natural Science, No. 4, pp. 270-274.

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J. Cairns Mitchell; Reports, Chester Society Natural Science, 1899-1901.

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J. Cairns Mitchell; Flora of Liverpool District, pp. 177-188.

North Coast of Wales—Climate of the.
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ERRATA:

In Nos. 24, 33, 362, 369, and 414, for "P. J. Barrand" read "P. J. Barraud."

In Nos. 521 and 523, for "Atchmere" read "Hatchmere."

In No. 193, for "broom" read "bloom."

,, 194, for "Cilcairn" read "Cilcen."

,, 318, for "J. Byron Denson" read "J. Lyon Denson."

PIERIDÆ.

PIERIS, Schrk.

1. **P. brassicæ,** L. Common throughout the district.

2. **P. rapæ,** L. Common throughout the district.

3. **P. napi,** L. Common throughout the district in suitable localities.

EUCHLOË, Hb.

4. **E. cardamines,** L. Occurs throughout the district, though somewhat rarely near the large towns in Cheshire.

LEPTIDIA, Billb. = LEUCOPHASIA, Stph.

5. **L. sinapis,** L. Local and rare.

C.—Said to occur near Parkgate (Bowell, N.); plantation between Hooton Station and Mollington (Gregson—*Naturalist*, 1885, p. 165).

COLIAS, Leach.

6. **C. hyale,** L. A very rare visitor. Recorded by Mr. Willoughby Gardner as having been taken near Conway, Carnarvonshire.

7. **C. edusa,** Fb. An occasional visitor.

C.—Bowdon 1877; not seen it since (Tp.); one at Guilden Sutton and one at Ellesmere Port 1901 (P.C.); several seen Dee Cop, Chester, 1900 (N.); Delamere 1877 (Mrs. Leather); ditto (A.); seen at Tarporley (Stk.); West Kirby 1900 (W.G.); the Cop, Chester (A., Da.); Storeton and Wallasey 1889 and 1893 (Pr.); o. near Malpas (F.H.W.D.); a. Wirral 1877 (Sh.); "I caught, perhaps, half-a-dozen specimens in my father's garden in Wardle Road, Sale, in 1877" (Chas. Oldham).

F.—Prestatyn 1900 (Pe.)

D.—Vale of Clwyd (W.G.); a. Colwyn Bay and Aber 1877 (W.G.); o. Colwyn Bay (N.)

Car.—Deganwy (W.G.); South Coast 1900 (Da., J.)

Ang.—One, Puffin Island (N.)

GONEPTERYX, Leach.

8. **G. rhamni,** L. Of very rare occurrence in the district.

C.—Bowdon, r. (Tp.); a hybernated male caught in garden, Tarvin Sands, April 21st, 1901 (Fr.); another, Chester Cop, about same time (N.); Delamere, two specimens (Mrs. Leather); ditto one in 1902 (Tp.); Bidston in 1875 (W.G.)

F.—Overton, o. (Pe.)

Car.—Conway Valley, o. (W.G.)

NYMPHALIDÆ.

NYMPHALINÆ.

PYRAMEIS, Hb.

9. **P. atalanta,** L. General and common throughout, some years more so than others.

10. **P. cardui,** L. Rather rare inland in Cheshire; more common on the coast at Wallasey, especially in some years (Pr., M.) Recorded from all the N. Wales counties. Periodically abundant in Anglesea (Po.) Flies round the hill-tops in Wales (Da.)

VANESSA, F.

11. **V. io,** L. Recorded generally throughout, though the species is not so common as it used to be. It appears to be scarce in East Cheshire. Larvæ always common in the Sealand district, near Chester, and abundant 1901 (A.)

12. **V. urticæ,** L. Very common everywhere throughout.

13. **V. polychloros,** L. Very unusual.

C.—One at Prenton (Brockholes); Chester 1859; Delamere—all recorded in *W.L.* Eastham (*Naturalist*, 1885, p. 168); Acton Bridge, taken by James Hirst (*E.L.*); Alderley, one in 1869 and one in 1870, H. H. Corbett (*E.L.*); near the Lodge Gates at Pettypool, R. Brown (*E.L.*); N. Cheshire, one pupa (N.G.)

Car.—Llandudno (Harding in *Ent.* XV., p. 64).

14. **V. antiopa,** L. A great rarity; only an occasional visitor.

C.—Prenton, Neston, Delamere, all in 1872 (*W.L*); one, Altrincham, Mr. Keyworth (*E.L.*); ditto one 1872 (Coward); one, Macclesfield Forest, Sept. 1858, Hugh Harrison (*E.L.*); one, Edge Park, Malpas, 1872 (C.W.D.)

D.—Pensarn 1872 (A. Barker).

Car.—Llyn Ogwen, June 1855 (S. Price in *Zoologist*, Vol. XIII., p. 4814).

POLYGONIA, Hb.

15. **P. c-album,** L. Of rare occurrence, and then only odd specimens, except at the Wyches, near Malpas (where it is recorded as locally common) and some parts of Wales.

C.—Delamere (Leather in *W.L.*), Bebington in 1873, Hooton, Tranmere, Ness, and Puddington, all recorded in *E.L.* A single specimen was taken on the railway embankment, Curzon Park, Chester, about 1870 (Da.); o. in garden at Edge, near Malpas (F.H.W.D.); locally c. at Wyches, Malpas (F.H.W.D.); Bowdon, r. (Tp.);

Vicar's Cross, near Chester (P.C.); N. Cheshire (N.G.); one in garden at Tarvin Sands about 1892, and a hybernated one in the following spring (F.); Delamere, one in 1894 (H.); Ince, o. (N., R. Newstead, Senr.); Bidston, one in 1885 (W.G.)

F.—Holywell (*W.L.*); Overton, m.c. (Pe., W.G.); Rhyl, July 22nd, 1897 (A. H. Thompson).

D.—Ruabon (*W.L.*); Colwyn Bay (*W.L.*, N., W.G.); Llandulas, one (P.C.); ditto, o. (Sh.); Ruthin (Ta.); Glyn Ceiriog, o. (Pe.); the Loggerheads, Sept. 1877 (J. H. Fowler); near Chirk (W.G.)

Car.—Bettws-y-Coed, o. (Pe., A.); Vale of the Conway, plentiful (Bl.); near Deganwy and Trefriew (W.G.)

MELITÆA, F.

16. **M. aurinia,** Rott. Extremely local, and in very few places.

C.—Near Malpas, a. (C.W.D.); one near Eastham (S. Archer); at Knutsford formerly, but has not been recorded from the locality for many years (Da.); recorded by R. S. Edelston in *Zoologist* for 1846, Vol. IV., p. 1220, as abundant in pasture fields at Stockport; but we have not heard of it occurring there in recent years.

Car.—A single specimen on the coast, 1900 (J.)

ARGYNNIS, F.

17. **A. selene,** Schiff. Very rare in Cheshire, but of general occurrence in N. Wales—in some places common.

C.—Delamere (*W.L.*); Macclesfield (*E.L.*); Hatchmere Moss, Delamere, in 1884 (Sh.)

D.—Nant-y-Glyn, Colwyn Bay (O. Whittaker); near Ruthin (W.G.)

Car.—Conway Valley (Bl.); near Deganwy, Bettws-y-Coed, and Trefriew (W.G.); South Coast, c. (J., Da., A.); Llandudno (*W.L.*)

18. **A. euphrosyne,** L. The same remarks apply to this species.

C.—Delamere (*W.L.*, Tp.); formerly at Knutsford (Tp.); Bromborough Woods (*E.L.*)

F.—Holywell (*W.L.*)

D.—Nant-y-Glyn and Colwyn Bay (O. Whittaker); Colwyn Bay (N.); near Ruthin (W.G.); Abergele (N.)

Car.—Bettws-y-Coed, c. (Pe., W.G.); Conway Valley (Bl.); near Abersoch (A., Da., J.); near Deganwy and Trefriew (W.G.)

19. **A. aglaia,** L. Rare in Cheshire, and not common anywhere in the district.

C.—Wallasey sandhills (*W.L.*); Ness (*W.L.*); Burton (*W.L.*)

F.—Wood near Rock Tavern, Holywell (*W.L.*)

D.—Coast near Abergele (W.G.); Corwen, one (Pe.); f.c., Beddgelert (Hannah, N.); Abergele (*W.L.*)

Car.—Near Deganwy (W.G.); inland, near Trefriew (W.G.); Pwllheli to Abersoch (A.); Abersoch (Da.)

20. **A. adippe,** L. More rare than the last.

C.—New Pale, Delamere (Nixon).

Car.—Abersoch (Da.); Gt. Orme, Llandudno (Harding in *Ent.* XV., p. 65).

21. **A. paphia,** L. Scarce generally.

C.—Wyches, near Malpas, n.v.c. (F.H.W.D.)

F.—Holywell and Bagillt (*W.L.*); Dee Valley, near Overton (W.G.); Rhyl, one (Pe.)

D.—Colwyn (*W.L.*, Imms); Abergele, f.c. (Hannah); Llandulas, n.c. (Sh.)

Car.—Near Conway and Trefriew (W.G.)

SATYRINÆ.

SATYRUS (Latr.) Westw.

22. **S. semele,** L. Common on the hills and near the coast throughout the district. Not recorded inland in Cheshire except from Malpas (on the authority of S. M. Johnson).

PARARGE, Hb.

23. **P. ægeria,** L. Occurs in all the counties (query Anglesea), but only very sparingly generally. Not found in E. Cheshire.

C.—Sparingly at Prenton, Denhall, and Puddington (*W.L.*); Delamere (J. C. Melvill in *E.L.*); N. Cheshire (N.G.); formerly in Eaton Park, near Chester (Da.)

F.—Common in woods (*W.L.*); Queensferry (*W.L.*); Overton, m.c. (Pe.)

D.—Common in woods (*W.L.*); Colwyn Bay (O. Whittaker); Llandulas, c. (P.C., Sh.)

Car.—Conway Valley, c. (Bl., W.G.); Bettws-y-Coed, o. (Pe.); near Deganwy, f. (W.G.); Penmaenmawr (Po.)

24. **P. megæra,** L. Common and generally distributed throughout, except in Cheshire east of Delamere Forest, from which district it appears to be entirely absent.

C.—Hoylake and district, c. (Da.); Malpas, c. (F.H.W.D., S. M. Johnson); Cheshire Coast, o. (J.); Wirral, a. (W.G.); the Cop, Chester, n.c., and Saughall (A.); N. Cheshire (N.G.); Tarporley (Stk.)

F.—Overton, c., Rhyl, o., and Cwm, c. (Pe.)

D.—Llandulas, f.c. (P.C.); Colwyn Bay district, sp. (N., O. Whittaker); the Loggerheads (A.)

Car.—On coast (J.); Llandudno, c. (Tp., A.); Bettws-y-Coed, c. (Pe.); Conway Valley (Bl.); Aber (P. J. Barrand),

Ang.—Lligwy, a. on cliffs near the sea (Ld. B.); a few, Puffin Island (N.)

APHANTOPUS, Wallgr.

25. **A. hyperantus,** L. The localities for this species are very few.

C.—Locally c. at Wyches, near Malpas (F.H.W.D.); Delamere, on the authority of J. C. Melvill in *E.L.*, but it has not been observed in this locality for some years past.

D.—Local, Llansannan, Abergele (Hannah).

Car.—Conway Valley (Bl.)

EPINEPHELE, Hb.

26. **E. jurtina,** L. = **janira,** L. Common throughout.

27. **E. tithonus,** L. Common throughout N. Wales; also in Wirral, and generally distributed in the rest of Cheshire, except in the N.E., where it is not recorded.

C.—Edge, near Malpas, c. (F.H.W.D.); Malpas, a. (S. M. Johnson); Saughall and Shotwick, a. (A.); Frankby (Da.); Heswall (Tp.); Wallasey (M.); ditto, now scarce (Pr.): N. Cheshire (N.G.); Delamere, n.c. (H.); Ince Marshes, sp. (N.); Tarporley (Stk.)

F.—Overton and Rhyl, c. (Pe.); Prestatyn and Mostyn (N.)

D.—Llandulas, f.c. (P.C.); Abergele and Colwyn Bay, c. (N.); Glyn Ceiriog, c. (Pe.); c. everywhere (A.); Clwyd Valley (F. Birch).

Car.—Llandudno, c. (G. Renshaw, N.); Conway c. (N.); Bettws-y-Coed, c. (Pe).

Ang.—Bull Bay and Amlwch (N.); Lligwy, f.a. (Ld. B.)

CŒNONYMPHA, Hb.

28. **C. pamphilus,** L. Generally distributed and common.

29. **C. tiphon,** Rott. = **typhon,** Hw., and **davus,** F. **Var. philoxenus,** Esp. We have no typical *tiphon* in the district. All the insects taken are dark, with numerous and large ocellated spots on the undersides, and vary considerably *inter se.* Very local, and found only on moss lands, but often fairly plentiful where it occurs.

C.—Recorded from Abbot's Moss, Clarke's Moss, Hatchmere, and Oakmere (all in the Delamere Forest district) by most of the local collectors; but the species has, apparently, been exterminated on some of the mosses; Wilmslow, r. (Tp.)

F.—Whixall Moss, c. (Th.)

D.—Minera Mountain (*W.L.*)

ERYCINIDÆ.

NEMEOBIUS, Stph.

30. **N. lucina,** L. The only records are :—

C. - Once taken between Eastham and Hooton (C. S. Gregson in *E.L.*)

Car.—Said to occur in a lane near Gloddaeth, Llandudno, Harding (*W.L.*)

LYCÆNIDÆ.

THECLA, F.

31. **T. w-album,** Knoch. Exceedingly rare in the district.

C.—Two recorded from the Wyches, near Malpas, by F.H.W.D. Delamere, one taken 1888 (Nixon), in collection Chester Museum.

F.—Miss Perkins bred the species from larvæ beaten from a wood bordering her garden at Ashgrove, Overton.

CALLOPHRYS, Billb.

32. **C. rubi,** L. In Cheshire appears to be found only in the Delamere Forest district. Recorded locally in all the N. Wales counties except Anglesea.

C.—Delamere Forest, recorded as c. by most of the local collectors; Sandiway and Abbot's Moss (Co.); Tarporley (Stk.)

F.—Larvæ beaten from wood bordering garden at Ashgrove, Overton (Pe.); Valley of the Dee near Overton (W.G.)

D.—Llangollen and near Ruthin (W.G.)

Car.—Abundant near Bettws-y-Coed (*W.L.*, Pe., W.G.); Conway Valley, c. (Bl.); Llandudno (*W.L.*); near Deganwy (W.G.)

ZEPHYRUS, Dalm.

33. **Z. quercus,** L. Of very rare occurrence in Cheshire; local and uncommon in N. Wales, except up the Vale of Conway, where it appears to be abundant.

C.—Eastham Wood (*W.L.*); Delamere (Leather, W.G., Tp., Jos. Chappell); Edge, near Malpas (C.W.D.); Wallasey, one 1887 (Pr.)

F.—Overton (W.G.); l. beaten from wood bordering garden at Ashgrove, Overton (Pe.)

D.—Gresford (F. Archer, Mr. Acton); Chirk (W.G.); Llandulas (Sh.)

Car.—Llandudno (Harding); Oak Woods, near Deganwy (W.G.); a. up Vale of Conway (W.G.): Aber (P. J. Barrand).

34. **Z. betulæ,** L. Recorded only from Denbighshire and Carnarvonshire.

D.—Hillside among birches, Berwyn 1875 (Sh.); near Chirk (Rev. —. Alderson).

Car.—Trefriew (W.G.)

CHRYSOPHANUS, Hb. = POLYOMMATUS, L.

35. **C. phlæas,** L. Common and generally distributed throughout.

LYCÆNA, F.

36. **L. argus,** L. = **ægon,** Schiff. Very local in Cheshire, where it appears to be confined now to the Delamere Forest district. Not recorded from Flintshire or Denbighshire.

C.—Whitegate Heath, local (Co.); Abbot's Moss (A.); Oakmere, c. (A., Stk., Da.); Delamere (M., W.G., H., N.); used to be taken on Bidston Hill, now extinct there (Pr.); formerly c. on Noctorum Heath, near Birkenhead, and Bidston (Sh., W.G.)

Car.—Abersoch, swarms on the sandhills (A., Da.); Orme's Head (W.G.)

Ang.—Near Holyhead, v.c. (R. Freer—*Ent. Rec.*, Vol. XII., p. 248).

37. **L. astrarche,** Begstr. = **medon,** Esp. Very local; not recorded from Cheshire or Anglesea.

F.—Wood, near Llyn Helig, and Talargoch, near Rhyl (*W.L.*)

D.—The Leet (A.); along Clwyd Hills, Cefn Caves, near Ruthin, and Bryn Euryn, near Llandrillo-yn-Rhos (W.G.): Llandulas (P.C.); ditto, on undercliff 1873 (Sh.); Colwyn Bay, c. on hills (N.); ditto, "including a variety with a white spot on each wing and black centres" (A. D. Imms).

NOTE.—This is apparently the variety **Artaxerxes,** F.—a very interesting record.—ED.

Car.—Llandudno and Gloddaeth (N.); Llandudno (G. Renshaw); Orme's Head (Po., W.G.); Sandhills, mouth of the Conway (W.G.)

38. **L. icarus,** Rott. Common and generally distributed throughout N. Wales; sparingly, Bull Bay district, Anglesea (N.); common in greater part of Cheshire, except in the east, where it is seldom seen near the large towns.

38a. „ **var. icarinus,** Scrb. Once, Wallasey sandhills (W.G.)

39. **L. minimus,** Fuessl. Very rare in Cheshire. Local in the Welsh counties, but generally common where it occurs. No records from Anglesea.

C.—Neston (C. S. Gregson in *E.L.*)

F.—Bagillt; the Loggerheads; and Talargoch (*W.L.*); Prestatyn (A.)

D.—Along Clwyd Hills and near Ruthin (W.G.); Llandulas (P.C.); Colwyn Bay (O. Whittaker); very local, but c. where it occurs in the Colwyn Bay district (N.)

Car.—Gloddaeth, near Llandudno (W.G.)

CYANIRIS, Dalm.

40. **C. argiolus,** L. Very local and uncommon generally.

C.—Delamere (*E.L.*); ditto, f.c., more so in some seasons than others (H.); N. Cheshire (N.G.); the White Hall, near Tarporley, n.c. (Stk.); Eastham and Hooton, taken by Mr. T. Harris (recorded in *E.L.* on the authority of C. S. Gregson).

F.—Lanes above Bagillt (*W.L.*); Halkyn and around Overton (W.G.); Overton, o. (Pe.); Nant-y-ffrith, a few (N.)

D.—Common, roadside holly fence, near Wrexham (N.); Colwyn Bay, sp. (N.); near Ruthin (W.G.); Llanferres (B.)

Car.—Bettws-y-Coed, f.c. 1893 (Pe.); ditto, plentiful on holly and abundant on ivy, Conway; also found near Deganwy (W.G.); swarming in road between Gwydyr Castle and Bettws-y-Coed; also sp. in the Conway Valley (Bl.); also recorded by T. B. Jefferys.

HESPERIIDÆ.

ADOPÆA, Wats.

41. **A. thaumas,** Hufn. Local and very seldom seen in Cheshire. Common but local in the Welsh counties.

C.—Eastham (F. Archer in *W.L.*); near Sutton, and once Raby mere (W.G.); Alderley, once in 1873 (W. W. Keyworth in *E.L.*); near Oakmere, Delamere (Jos. Chappell in *E.L.*); Hooton, July 1878, on a rough piece of ground over which the Manchester Ship Canal now passes (Sh.); Malpas 1900 (S. M. Johnson).

F.—Overton and Cwm, c. (Pe.); Rhyl, c. (Pe.)

D.—Glyn Ceiriog (Pe.)

Car.—Deganwy (W.G.); Llandudno (Harding in *W.L.*)

AUGIADES, Wats.

42. **A. sylvanus,** Esp. Local and seldom seen in Cheshire. Recorded from all the N. Wales counties except Anglesea, where, no doubt, it also occurs.

C.—Between Raby and Bromborough (*W.L.*); recorded from Knutsford by Jos. Chappell in *E.L.*, but the species has not been found there for many years; throughout Wirral (J. F. Brockholes in *E.L.*); Goostrey, c. (Tp.); N. Cheshire (N.G.); Ince Marshes, sp. (N.); Whixall Moss, near Fenn's Bank Station 1898 (Th.)

F.—Bagillt (*W.L.*); along Flintshire Coast (W.G.); Overton, o. (Pe.)

D.—Colwyn Bay, a few (N.); ditto, one (O. Whittaker); Cefn Caves and near Ruthin (W.G.)

Car.—Generally c. near the sea (A.); Conway Valley, v.c. (Bl.); Abersoch, n.c. (Da.); Mouth of the Conway (W.G.)

HESPERIA, Wats.

43. **H. malvæ,** L. Recorded only from Denbighshire, viz.: at Cefn Caves and near Ruthin (W.G.)

THANAOS, B.

44. **T. tages,** L. Rare and local in Cheshire; local but fairly common in N. Wales. The larva hybernates in a case formed by spinning together grass stems (*W.L.*)

C.—Common on railway banks in Wirral, as between Spital and Bromborough (J. W. Ellis in *E.L.*); formerly at Gill Brook, near Flaybrick—situation now destroyed (Pr.); Ledsham, once only, May 1893 (Sh.); N. Cheshire (N.G.); near Bromborough (W.G.); Shavington Park, on border of Cheshire and Salop 1896 (Th.); Cottrell Wood (R. S. Edelston in *Zoologist*, 1844, pp. 734 and 735.

F.—Bagillt (*W.L.*); along the Flintshire Coast (W.G.)

D.—Colwyn Bay (*W.L.*); ditto, c. (O. Whittaker); Llandulas, a few (P.C.); a. Abergele and Pensarn, Colwyn Bay, Minera, and Llangollen districts (N.); Llanferres, Cefn Caves, and near Ruthin (W.G.)

Car.—Llandudno, and generally present in all limestone districts in the adjoining localities (N.); Conway Valley, v.c. (Bl.); and mouth of the Conway (W.G.); North Cardigan Bay (W.G.); Capel Curig (B.)

SPHINGIDÆ.

ACHERONTIA, O.

45. **A. atropos,** L. Occasional throughout the district, some years more plentiful than others. No records from Anglesea.

C.—Christleton 1858; Tattenhall (Manning); Saughall, near Chester (Shrubsole); l.n.u. at Upton, near Birkenhead (Archer); all recorded in *W.L.* Tranmere 1895 (Pr.); Wallasey 1887, l. (Pr.); Vicar's Cross (P.C.); Chester and the county generally, n.c. (A.); Bowdon (Tp); near Knutsford 1901 (Da.); Lady Leighton Warren furnishes a record of a specimen taken at Tabley, near Knutsford, in 1825, by Sir John Leicester; Eccleston, one 1899 (Do.); Kinnerton, l. 1900 (Do.); Hoylake, formerly c. (W.G.); near Malpas, l. 1900 (Th.); l.v.c. at Farndon 1900 (N.); Carrington, two l. 1901 (Stb).

F.—Bagillt (*W.L.*); near Overton, o., chiefly l. (Pe.); Overton, o. (W.G.)

D.—Colwyn Bay, several l. 1885 (N.)

Car.—Abersoch, o. (A.); Deganwy, especially in 1900 (W.G.)

SMERINTHUS, Latr.

46. **S. populi,** L. Common throughout the district.

47. **S. ocellata,** L. More or less common throughout the district; generally seen in the larva state, but imagines recorded at e.l., Chester.

DILINA, Dalm. = SMERINTHUS, O.

48. **D. tiliæ,** L. Of very rare occurrence in the district; one recorded at electric light, Chester, in 1899, by Mr. H. Quinton; and one taken at Erbistock (Flintshire) by Miss Perkins in 1870.

SPHINX, O.

49. **S. ligustri,** L. Of very rare occurrence in the district.

C.—Bowdon, r. (Tp.); one at e.l., Chester 1898 (Do.)

F.—Rhyl, one 1892 (Pe.)

PROTOPARCE, Brm. = SPHINX.

50. **P. convolvuli,** L. Occurs occasionally—probably over the whole of the district.

C.—Eaton Park, near Chester, 1873, Oxton, and Denhall (*W.L.*); one at Netherleigh, Chester (J. Thompson); near Chester 1886 and 1892 (N.); Chester, o. (A.); Vicar's Cross, near Chester (P.C.); Ince 1888 (R. Newstead, Senr.); Bowdon (Tp.); Little Budworth 1897, at rest (Stk.); Wallasey 1897 (Pr.); Tarvin Sands garden, one about 1893 (F.); Alderley Edge 1900 (Chas. Oldham).

F.—Bagillt 1859 (*W.L.*); Rhyl, one in 1890 and one perfectly fresh, 1896 (Pe.)

D.—Near Chirk (Rev. — Alderson).

Car.—Llanfairfechan (J. A. Jenkinson).

DEILEPHILA, O.

51. **D. gallii,** Rott. = **galii,** Schiff. A very occasional visitor.

C.—One in a greenhouse at Ashton-upon-Mersey (Stb.); the following records are all from Wallasey sandhills:—1870, 1888 (a.), and 1897 (W.G., Pr.); l. (A., Tp.); l.a. in 1888 (N., Sh.)

F.—"I made a search in its old haunts at Prestatyn in 1888, but there were no signs of the l. there" (N.)

Car.—Abersoch, one l. 1897 (Da.)

52. **D. euphorbiæ,** L. There are no recent records. The following extract is from *E.L.*, p. 14:—"A specimen, now in the cabinet of Mr. C. S. Gregson, captured in an outhouse at Bidston, near Birkenhead, by W. Morgan; two larvæ, found on *Euphorbia paralias* between Little Brighton and Hightown by C.S.G."

CHÆROCAMPA, Dp.

53. **C. celerio,** L.

C.—Alderley Edge, in May 1878 (W. W. Keyworth—*Ent.* XI., p. 160, *E.L.*)

Car.—One specimen, July 1865, near the Menai Suspension Bridge (G. T. Porritt).

54. **C. elpenor,** L. Generally distributed throughout, though by no means common everywhere.

C.—Delamere (Leather in *W.L.*); Cuddington, s., Oakmere district, a. (N.); Bidston Marsh (W.G.); ditto, now rare (Pr.); Wallasey, l. (H.); near West Kirby (Da.); n.u., e.l., Chester (Do., A.); f.c., e.l., White Hall, near Tarporley (Stk.); Malpas (F.H.W.D.); Rostherne, Knutsford, and Warburton (Tp.); Wybunbury Moss, l. (Mr. Daltry).

F.—Overton, o. (Pe.)

D.—Near Chirk (W.G.); Colwyn Bay, one (N.)

Car.—Near Deganwy (W.G.); Pwllheli 1895 (J.); Abersoch 1900 (J., Da.)

METOPSILUS, Dunc.

55. **M. porcellus,** L. Occurs throughout the district, and found more commonly than the last species.

C.—Freely distributed throughout the county, but more frequently met with on the coast (Pr.); Wallasey (J.); ditto, both l. and imago (M.); ditto, and near Hoylake (W.G.); West Kirby (Sh.); Delamere (Leather in *W.L.*); f.c., e.l., White Hall, near Tarporley (Stk.); Bowdon, very local (Tp., Da.); Knutsford (Da.)

F.—Rhyl, c. in 1900 (Pe.); ditto (W.G.)

D.—Near Chirk (W.G.)

Car.—Abersoch, c. (Da., A.); ditto, f.c. at silene and yellow iris flowers (J.); Deganwy, at rhododendron flowers (W.G.)

Ang.—Near Holyhead, c. 1900 (R. Freer—*E.M.M.*, Vol. XII., p. 13).

MACROGLOSSA, Sc.

56. **M. stellatarum,** L. Generally distributed throughout the district, commoner some years than others. More plentiful on the coast, both of Cheshire and N. Wales, than inland.

HEMARIS, Dalm. = MACROGLOSSA, Sc.

57. **H. scabiosæ,** Z. = **bombyliformis,** Esp. "Two specimens recorded as captured at Bidston (Cheshire), by C. S. Gregson" (*E.L.*)

NOTODONTIDÆ.

CERURA, Schrnk.

58. **C. bicuspis,** Bkh. Mr. F. C. Woodforde records having taken two larvæ at Wybunbury Moss, Cheshire. Two fine specimens were taken at electric light at White Hall, near Tarporley, in 1901 and 1902, by Mr. J. H. Stock.

59. **C. furcula,** Cl. Recorded from Cheshire and Carnarvonshire only, but would probably be found generally distributed if carefully searched for in larval stage.

C.—Wirral, s. (*W.L.*); N. Cheshire (N.G.); Delamere (Leather in *W.L.*), ditto, one l. 1900 (Ta.); ditto, one specimen (N.); Chester, one at e.l. 1898 (Do.); ditto, o. at e.l. (A.) "Have found empty cocoons on trunks of poplars and willows at Elton Green and Thornton, near Ince" (Co.)

Car.—Abersoch, l., n.u. (Da.)

60. **C. bifida,** Hb. This is an insect that the electric light has proved to be more common at Chester than was generally supposed. It is found very sparingly in the district generally.

C.—Chester, c. at e.l. (A., Do., N.); one at e.l., White Hall, near Tarporley (Stk.); Chester, l.o. on poplars (A.); Knutsford, l.o. (Da.); Delamere, l. 1897 (H.); Wallasey, s. (Pr.); Hale, n.c. (Tp.); N. Cheshire (N.G.)

F.—Overton, pupæ, local (Pe.); Holywell (J. F. Brockholes in *W.L.*); Caergwrle, empty cocoons (B.)

D.—Llanferres (B.)

DICRANURA, B.

61. **D. vinula,** L. Occurs commonly throughout the whole of Cheshire. Recorded as moderately common in Flintshire, abundant in parts of Denbighshire. Occurs at Deganwy, in Carnarvonshire, but not recorded from Anglesea, though the omission is probably due to lack of observers.

DRYMONIA, Hb.

62. **D. trimacula,** Esp. = **dodonæa,** Hb. Recorded from East Cheshire on the authority of N. Greening in *W.L.*; also from Bowdon, Cheshire (not common), by J. Thorpe. It has not been found in recent years.

63. **D. chaonia,** Hb. Of very infrequent occurrence.

C.—Delamere Forest, n.c. (R. Tait, junr.); ditto in 1892 (T. G. Mason); recorded also from Eastham Wood, one (N. Cooke in *W.L.*), and from Dunham Park, near Bowdon, r., and Timperley a single specimen (J. Chappell in *E.L.*); two at Hooton (T. Harris in *E.L.*)

Car.—Bettws-y-Coed, three specimens, April 1893 (Miss Perkins).

PHEOSIA, Hb.

64. **P. tremula,** Cl. = **dictæa,** Esp. Appears to be generally distributed, but found, as a rule, only occasionally, chiefly in the larval stage. The perfect insect, however, has been taken freely at electric lights, Chester.

C.—Wirral (*W.L.*); Wallasey, l. (J., Ta., Da.); ditto, s. (M., Pr.); N. Cheshire (N.G.); Delamere, l. (A.); Whitegate Heath, l. in aspen poplar, Aug. (Co.); Ashley (Tp.); Ashton-on-Mersey, l. (Stb., Da.); Knutsford, l.o. (Da.); White Hall, near Tarporley, o. at e.l. (Stk.); Chester, c. at e.l. (N., Do., A.); Wybunbury Moss (F. C. Woodforde).

F.—Holywell (*W.L.*); Rhyl, o. (Pe.); near Rhyl (W.G.); Prestatyn, s. (N.)

Car.—Near Conway (W.G.)

65. **P. dictæoides,** Esp. Rather more uncommon than the last. The larvæ seem to affect birches growing on moss-lands. The records are all from Cheshire.

C.—Bidston, s. (*W.L.*); ditto, on birch (Pr.); Delamere, l., o. (J., M., Ta.); ditto, s. (A.); ditto, l., Oct. 1898 (Th.); ditto, imagines o. at rest on tree trunks (Da.); Whitegate Heath, l. on birch, Sept. (Co.); Ashton-on-Mersey, l. (Stb.); Warburton (Tp.); Wybunbury Bog (F. C. Woodforde); ditto, l., Sept. 1888 (Th.); Chester, at e.l., n.c. (A.); ditto, several (Do.); ditto, s. (N.); White Hall, near Tarporley, o. at light (Stk).

NOTODONTA, O.

66. **N. ziczac,** L. Widely distributed in Cheshire, but by no means general. No records from the Welsh counties, except from Flintshire.

C.—Wirral (*W.L.*); Wallasey (J., M.); ditto and Flaybrick, n.c. (Pr.); Delamere (Leather in *W.L.*); ditto, l. 1900 (H.); Walton, near Warrington (Co.);

Vicar's Cross, near Chester, bred from l. (P.C.); o. at e.l., White Hall, near Tarporley (Stk.); Chester, n.u. at e.l. (Do.); ditto, s. (N.); ditto and gas lamps (A.); l., c. in the Chester district on sallow and poplar (A); Stockport, l., sp. (J.); Knutsford, l., o. (Da.)

F.—Near Holywell, l., c. (*W.L.*)

67. **N. dromedarius,** L. Common generally on the mosses where the larvæ feed on the birch bushes. Not often seen except in the larval stage, though the perfect insect has been taken at light. The imagines in this district are of a rich dark-brown colour, much darker than the type, and showing very little trace of the blood-red markings of the southern form.

C.—Wirral (*W.L.*); Delamere, l. (Ta., M., Da., J.); ditto and Oakmere, f.c. (N.); ditto, red and type forms of l., c. (A.); Sale and Dunham, l. (Ta.); Carrington (Stb.); ditto, l. used to be common on the Moss (Da.); Bowdon (Tp.); Bidston, on birch n.c. (Pr.); once at Stockport (J.); Chester, four or five at e.l. in 1899 and 1900 (Do.); ditto, o. in Aug. (A.); Wybunbury Bog, l. (F. C. Woodforde); ditto, Sept. 1888 (Th.)

D.—Colwyn Bay, l. on hazel (*W.L.*); ditto, l., s. (N.)

68. **N. trepida,** Esp. Local and rarely met with.

C.—Northwich, one (Tp.); Mr. Thorpe states that his brother took another specimen near the same spot subsequently; Delamere Forest—recorded in *E.L.* on the authority of S. J. Capper, J. C. Melvill, and E. C. Buxton in *Zoologist*, IX., 1851, p. 3181; Pettypool Wood, May 1851—N. Cooke in *Zoologist*, Ser. 1., Vol. X., p. 3515. Also recorded in Cheshire, within twelve miles from Warrington, by N. Greening.

LOPHOPTERYX, St.

69. **L. camelina,** L. Fairly common, and generally distributed in suitable localities, such as moss-lands and woods with birch undergrowth.

C.—Chester district, c. (A.); Chester, two or three at e.l. 1898, 1899, and 1900 (Do.); the White Hall, near Tarporley, at light (Stk.); Delamere (Cr., J., N., Da., H., M., Ta.); Whitegate Heath, l. (Co.); Wallasey, l. (M.); ditto, n.v.c. (Pr.); Oxton and Hooton (Sh.); Stockport, o. (J.); Carrington (Stb.); Wybunbury Moss (F. C. Woodforde).

D.—Colwyn Bay, sp. (N.)

Car.—Near Deganwy (W.G.)

PTEROSTOMA, Gm.

70. **P. palpina,** L. Exceedingly rare.

C.—A single specimen at Puddington in 1864 (J. F. Brockholes in *W.L.* and *E.L.*); Delamere, l. on birch, n.c. (A.)

D.—Colwyn Bay, s. (N.)

PHALERA, Hb.

71. **P. bucephala,** L. Common throughout—occasionally abundant.

LYMANTRIIDÆ.

ORGYIA, O.

72. **O. antiqua,** L. Common throughout.

DASYCHIRA, Stph.

73. **D. fascelina,** L. Recorded from very few localities.

C.—Used to be c. on Wallasey sandhills, but of late years v.s. (Pr.); Bowdon, l., r. (Tp.)

Car.—Deganwy sandhills (W.G.); near Llandudno (A., N.)

74. **D. pudibunda,** L. Widely distributed, but nowhere common.

C.—Delamere district, o, recorded by all the local collectors; Chester, e.l. (A., Do.); White Hall, Tarporley, o. (Stk.); Eastham Wood (R. Wilding in *E.L.*); Rock Ferry, formerly (W.G.); Bidston, n.c. (Pr.); Shavington Park, borders of Cheshire and Salop, l. 1899 (Th.)

F.—Overton, o. (Pe.); Rhydymwyn, l. (B.)

D.—Vale of Clwyd, formerly (W.G.)

Car.—Conway Valley (Bl.); Pwllheli, a few l. 1895 (J.)

Ang.—Lligwy, l. (Ld. B.)

PORTHESIA, Stph.

75. **P. similis,** Fuessl. Abundant throughout.

STILPNOTIA, Westw. and Hump.

76. **S. salicis,** L. Abundant along the north coast of Wirral, and taken occasionally at electric light, Chester, but not recorded from the rest of the district.

C.—Chester, o. at e.l. (A., Do.); Wallasey, c. (M., W.G.); Hoylake, a. (A., Pr., Ta., W.G.); West Kirby, l., a. (Sh.); N. Wirral, a. (N., J.)

LASIOCAMPIDÆ.

MALACOSOMA, Auriv.

77. **M. neustria,** L. South Carnarvonshire appears to be the only locality in the district where the species is common. Recorded sparingly from Wirral, Flintshire, and Denbighshire.

C.—Upton Valley and Ness (*W.L.*); Chester, at e.l., twice only (Do.); Hoylake (W. Johnson in *E.L.*); West Kirby (C. S. Gregson in *E.L.*)

F.—Overton, s. (Pe.)

D.—Colwyn (*W.L.*)

Car.—Near Conway (W.G.); l., v.c. on south coast 1900 (J., Da.)

TRICHIURA, Stph.

78. **T. cratægi,** L. Very rare. The few records are all in Cheshire.

C.—"Reared from larva found at Saighton, near Chester, by Miss H. Smith, Hampton Lodge, Chester" (*W.L.*); Aldford, near Chester, one at light 1900 (N.); Edge, near Malpas, at light, r. (F.H.W.D.)

PŒCILOCAMPA, Stph.

79. **P. populi,** L. Of general occurrence.

C.—Bidston (*W.L.*); Ashton-on-Mersey, at light (Stb); c. some years at gas lamps north Birkenhead (Pr.); Bowdon, n.c. (Tp.); Knutsford, o. (Da.); Delamere, l. (J.); Pettypool Wood, l. (Co.); White Hall, Tarporley, several at e.l. 1900 (Stk.); Chester (Da., N.); ditto, six at e.l. 1898 (Do.); ditto, c. at e.l. and gas lamps (A.)

F.—Loggerheads (*W.L.*); Cwm, near Rhyl, o. (Pe.)

D.—Colwyn Bay, l., c. (N.); Ruthin (Allen in *Ent. Rec.* III., p. 15).

Car.—Bettws-y-Coed (*W.L.*); near Conway (W.G.)

ERIOGASTER, Gem.

80. **E. lanestris,** L. Rather local; not recorded from E. Cheshire.

C.—Upton, near Birkenhead and Chester (*W.L.*); near West Kirby (Da.); bred from Tranmere, Prenton, and Parkgate (W.G.); "Thingwall and Wallasey, not so c. as in former years. I took a variety in Feb. 1899, at night, off hawthorn twig at Wallasey, now in Mr. Capper's collection" (Pr.); Delamere, l. fairly c. (H.); Burleydam, l. 1900 (Th.); Chester, l., o.a. on hawthorn on south side (N.); only seen as nests of l. on south of Chester, as far as Lache Eye (A.)

F.—Cwm, near Holywell, and Loggerheads (*W.L.*); Overton and Rhyl, c. (Pe.)

D.—Colwyn (*W.L.*, N.); Abergele, l., v.c. on birch (N.)

Car.—Conway, l. (Ta.); near Trefriew, l. (B.); near Deganwy (W.G.)

LASIOCAMPA, Schrk. = BOMBYX, B.

81. **L. quercus,** L. More or less common throughout; generally seen in larval stage. Mr. C. F. Johnson records "an olive banded dark-coloured female variety, taken at rest, Wallasey (Cheshire) 1897." Mr. Prince states that the larvæ found at Wallasey are the true *quercus*.

81a. „ **var. callunæ,** Palmer. Recorded by Miss Perkins from Overton (Flintshire).

82. **L. trifolii,** Esp. Recorded only from Wallasey Sandhills (Cheshire) (A.); "ditto, common in former years, but the habitat is now spoiled by building and traffic" (Pr.)

MACROTHYLACIA, Rbr. = BOMBYX, B.

83. **M. rubi,** L. More or less common in all the counties. Confined principally to heaths; the hills and mountains; and sandhills along the coast. Very abundant in Anglesea (A., N., Ld. B.)

COSMOTRICHE, Hb.

84. **C. potatoria,** L. Common in the Wirral district of Cheshire and in many parts of N. Wales. Found locally in mid-Cheshire, but is more scarce eastward.

SATURNIIDÆ.

SATURNIA, Schrk.

85. **S. pavonia,** L. = **carpini,** Schiff. Found on most heaths throughout the district; common in some places. Mr. C. F. Johnson records that a large strawberry bed in a private garden at Wilmslow, Cheshire, was eaten almost bare by the larvæ of this species in 1897. Larvæ common on sallow at Abersoch, Carnarvonshire (Da.)

DREPANIDÆ.

DREPANA, Schrk.

86. **D. falcataria,** L. = **falcula,** Schiff. Local, but common where it occurs.

C.—Delamere, c. (by all the local collectors); Chester, at e.l. (Do.); White Hall, Tarporley (Stk.); Abbot's Moss Woods (Co.); Holford Moss, c. (Da.); Wilmslow, n.c. (Tp.); Wybunbury Bog, l., Sept. 1888 (Th.)

D.—Llangollen (A.)

87. **D. lacertinaria,** L. = **lacertula,** Schiff. Rather more uncommon than the last.

C.—Delamere (by all the local collectors); near Knutsford, s., and Holford Moss, n.u. (Da.); Wilmslow, c. (Tp.); Wybunbury Bog, l., Sept. 1888 (Th.)

CILIX, Leach.

88. **C. glaucata,** Sc. = **spinula,** Schiff. Generally distributed in Cheshire (very common about Chester); recorded from Flintshire and Denbighshire, but not further west.

C.—Wirral, Delamere, and Chester (*W.L.*); Oxton (Sh.); Leasowe, sp. (Pr.); Delamere 1899 (H.); Chester, c. at e.l. (Do., A.); ditto, v.c. in Sealand district (A.); Vicar's Cross, near Chester, f.c. (P.C.): Ince Marshes, frequent (N.); Ashton-on-Mersey and Holford Moss (Da.); Carrington (Stb.); near Tarporley (Stk.); Malpas, c. at light (F.H.W.D.); Stockport, c. (J.)

F.—Overton and Rhyl, m.c. (Pe.); Queensferry, c. (Do.)

D.—Colwyn Bay, frequent (N.)

NOCTUIDÆ.

ACRONYCTINÆ.

DEMAS, Stph.

89. **D. coryli,** L. Only one record—a larva taken by G. O. Day near Whaley Bridge, in the extreme east of Cheshire.

ACRONICTA, O.

90. **A. leporina,** L. Local, but not uncommon where dwarf birches grow in woods and on mosses.

C.—Bidston, s. (*W.L.*); Whitfield (Archer in *W.L.*); Chester, e.l., s. (A.); ditto, one 1899 (Do.); Delamere, as l. chiefly (A., N., Ta., M., H., Da.); near Abbot's Moss Wood, Delamere (Co.); near Tarporley, three (Stk.); Carrington (Stb.); Dunham, near Altrincham, three in 1900 (Ta.); Warburton, n.c. (Tp.); Holford Moss (Da.); Little Sutton, l. (Sh.); Wybunbury Moss (F C. Woodforde).

F.—Llyn Helig (*W.L.*)

91. **A. aceris,** L. Has not been found in the district for many years. Two old records for Cheshire are: Ashton-on-Mersey, not common (Jos. Chappell in *E.L.*); and Delamere (Mr. Leather in *W.L.*)

92. **A. megacephala,** F. Common generally. Not recorded from Carnarvonshire and Anglesea; though it probably occurs wherever there are poplars.

C.—Common throughout.

F.—Overton, o. (Pe.)

D.—Wrexham (Frater); Colwyn Bay (N.)

93. **A. alni,** L. Larvæ generally found singly and often ichneumoned. Widely distributed in Cheshire, but by no means plentiful. In G. O. Day's collection is a specimen with the forewings entirely black (bred from larva found at High Legh, Cheshire); and several nearly as dark have been taken at electric lamps at Chester by Messrs. Arkle and Dobie; and at White Hall, Tarporley, by Mr. J. H. Stock.

C.—Delamere, l. 1877 (Leather in *W.L.*); ditto, one l. 1899 (H.); Chester, f.c. at e.l. (A , N.); ditto, seven in 1899 and 1900 (Do.); White Hall, Tarporley, six at e.l. 1900, including black variety (Stk.); Manley and Eaton, near Chester, l. (N.); Little Budworth, black variety at e.l. (N.); Dunham Park, in 1842 (J. B. Hodgkinson in *E.L.*); ditto, in 1872 and 1879 (J. Chappell in *E.L.*); ditto, at sugar and also as l., n.c. (Tp.); Hale Moss, near Altrincham, Aug. 1863 (E. M. Geldart in *E.L.*); Marple (J. Chappell in *E.L.*); Knutsford, l. (Da.)

F.—Overton, one bred on alder (Pe.)

Car.—Trefriew (Bl.)

94. **A. tridens,** Schiff. Extremely rare or else not observed.

C.—Wallasey and Ness, s. (*W.L.*); Chester (Miss Smith in *W.L.*); one l. near Chester (N.); e.l. possibly, but cannot be distinguished from the following species (A.); N. Cheshire (N.G.)

D.—Vale of Clwyd (W.G.); Colwyn Bay, two (N.)

95. **A. psi,** L. Common everywhere throughout.

96. **A. menyanthidis,** Vieweg. Local and uncommon.

C.—Abbot's Moss, Delamere, n.c. (Da.); White Hall, near Tarporley, a few (Stk.); Lindow Common (Tp.); Macclesfield, c. as l. (R. South).

F.—Minera district (N.)

D.—Llangollen (B.)

97. **A. rumicis,** L. General all over the district. The dark variety, **salicis,** Curt., is frequently taken on the mosslands.

CRANIOPHORA, Snell.

98. **C. ligustri,** F. Only one record.

C.—Taken at Old Marsh Lane, Ince, by Mr. Newstead (*W.L.*)

TRIFINÆ.

AGROTIS, O.

99. **A. strigula,** Thnb. = **porphyrea,** Hb. Tolerably common wherever there are large tracts of heather.

C.—Claughton Fir Wood, Prenton Mount Wood (*W.L.*); Storeton and Wallasey (*E.L.*); Bidston (Pr.); ditto and West Kirby (Sh.); Delamere Forest, Carrington Moss, and Staley Brushes (*E.L.*); Abbot's Moss (Ca.); White Hall, near Tarporley (Stk.); Chester, f.c. at e.l. (Do.); Whaley Bridge (J.)

F.—Loggerheads, Moel Fammau (*W.L.*); Whixall Moss (Th.)

D.—Llyn Aled, v.a. (F. Birch); Llangollen (W.G.)

Car.—Penmaenmawr (Po.); on coast 1900 (J.); Abersoch (Da.); near Conway (W.G.)

Ang.—Near Holyhead 1900 (R. Freer).

100. **A. janthina,** Esp. Widely distributed but not generally common.

C.—Wirral, n.a., and Chester (*W.L.*); Delamere, West Kirby, Tranmere, Rock Ferry, and Wallasey (*E.L.*); Bowdon (Tp.); Chester c. at e.l. (Do., A., N.); White Hall, Tarporley (Stk.); Kennel Wood, Sandiway, l. (Co., Da.); Ince Marshes, s. (N.); Stockport, l. (J.); Vicar's Cross, near Chester, c. (P.C.)

F.—Holywell (*W.L.*); Overton, o. (Pe.); Rhyl, c. (Pe.)

D.—Vale of Clwyd (W.G.); Llandulas, v.c. (P.C.)

Car.—Penmaenmawr, a. (Po.); Conway (W.G.); Llanfairfechan and Bangor (Ta.)

Ang.—Lligwy (Ld. B.)

101. **A. fimbria,** L. Generally distributed and fairly common.

C.—Wallasey, Claughton, Eastham Wood, Denhall, Puddington, s. (*W.L.*); Bowdon (Tp.); Chester, o. at e.l. (A., Do.); ditto, l. (A.); Delamere, at sugar (H., Da., Cr., Ta.); Kennel Wood, Sandiway, l.c. (Co., Da., M., J.); Vicar's Cross, near Chester, s. (P.C.); Stockport, l. (J.)

F.—Holywell (*W.L.*); Overton, o. (Pe.)

D.—Colwyn Bay (N.)

Car.—Penmaenmawr (Po.); near Conway (W.G.); Llanfairfechan, l. (Ta.)

102. A. **interjecta,** Hb. Of infrequent occurrence.

C.—Wallasey, Rock Ferry, s., and Chester (*W.L.*); New Brighton at ragwort flowers, and Parkgate (*E.L.*); Delamere Forest, l., r. (Da.); Chester (N.); ditto, one at e.l. 1900 (Do.); Wallasey, one at ragwort 1900 (Ta.); ditto, o. (Pr.); Bowdon (Tp.)

F.—Overton, o. (Pe.)

D.—Llandulas (Sh.)

103. A. **augur,** F. Common and generally distributed.

C.—Wirral (*W.L.*); Wallasey (M., Pr.); Chester, e.l. (Do.); near Chester, l., c., imago at sugar (A.); Ince Marshes (N.); Vicar's Cross (P.C.); Delamere, c. at sugar (H.); Knutsford (Da.); Bowdon, at sugar (Tp.); Dunham, at sugar (Ta.)

F.—Holywell and Loggerheads (*W.L.*); Rhyl and Overton, m.c. (Pe).

D.—Colwyn Bay (N.)

Car.—Penmaenmawr, a. (Po.)

104. A. **pronuba,** L. Exceedingly abundant everywhere and in endless variety.

105. A. **comes,** Hb. Abundant throughout.

106. A. **castanea,** Esp. This—the brick-red form—is the rarest with us. The variety *neglecta*, Hb., with the light-drab forewings, is the usual form wherever the species is found in the district; but the insect is local and appears to occur in very few places.

C.—Rudheath, a few 1900 (Da.)

Car.—Abersoch, a few 1897 (Da.)

106a. „ **var. neglecta,** Hb.

C.—Once at Oxton (W.G.); Delamere (A.); Rudheath, fairly plentiful in 1900 (Da.)

Car.—Abersoch, n.u. (Da.)

107. A. **agathina,** Dup. Local and rare.

C.—Wallasey, one specimen taken by Mr. Almond in 1854 (*E.L.*); Bidston Hill, o. (*E.L.*); ditto, l., n.u. (Pr.); near Abbot's Moss, Delamere, l., June; imagines, August (Co.); White Hall, near Tarporley, one (Stk); Wilmslow (Tp.)

Car.—Penmaenmawr, l. (Ta.)

108. **A. triangulum,** Hufn. Generally distributed and not uncommon.

C.—Wirral, n.v.c., Chester (*W.L.*); Wallasey, s. (*E.L.*, Pr.); Bidston (Sh.); Chester, e.l. (Do.); ditto, at sugar, s. (A.); White Hall, near Tarporley (Stk.); Delamere, l., c. (Ta., M., Co., J., Da.); Knutsford (Da.); Dunham, sugar (Ta.); Hale (Tp.); Staley Brushes, n.c. (*E.L.*)

F.—Rhyl (*W.L.*); ditto, c.; also at Overton (Pe.)

D.—Colwyn Bay (N.)

Car.—Penmaenmawr, a. (Po.); Deganwy (W.G.); Abersoch, c. (Da.)

109. **A. baja,** F. Generally distributed and not uncommon.

C.—Wirral (*W.L.*); Wallasey, at flowers and sugar (Pr., H., M.); Bebington (Sh.); Chester, e.l. (Do., N., A.); Delamere, c. at sugar (H.); ditto, l., c. (J., Da.); White Hall, near Tarporley (Stk.); Hale (Tp.); Stockport, l. (J.)

F.—Holywell and Loggerheads (*W.L.*); Overton, c. (Pe.)

D.—Colwyn Bay, one (N.)

Car.—Abersoch, c. (Da.)

110. **A. ashworthii,** Dbld. Extremely local and restricted, though fairly plentiful in the few places it favours—all on carboniferous limestone formation.

F.—The following records for the County all refer to the same range of rocks:—Loggerheads (*W.L.*, A.); the Leet, near Mold, l. (A., N.); Llanferres, near Mold, l. (W.G., Sh.); Rhydymwyn (Da.)

D.—Llangollen (Ashworth in *W.L.*); Eglwyseg Rocks, near Llangollen (W.G., A., B.) There is an interesting article by Mr. Willoughby Gardner in *Ent.*, XXIII., pp. 5 to 8, with regard to the discovery, &c., of the species in this locality.

Car.—Mr. G. T. Porritt was the first to record the species from Penmaenmawr, where, he states, it is common on the mountains. Both imagines and larvæ are recorded also from Penmaenmawr by Mr. R. Tait, junr. The species in all stages is recorded from the mountains between Penmaenmawr and Conway by Messrs. W. Gardner, F. H. Wolley-Dod, G. O. Day, and B. Harvey-Jellie, B.A. Mr. Wolley-Dod states that the ova are found commonly on dead plant stems growing on the rocks, and occasionally on the rocks themselves.

111. **A. c-nigrum,** L. Generally distributed and fairly common.

C.—Wallasey, a. (*W.L.*); ditto (Pr.); Bidston (Sh.); Chester, at e.l. v.c.—two broods June and Sept.—the latter much smaller (Do., A.); Ince Marshes and Helsby (N.); Delamere (M., H.); White Hall, near Tarporley (Stk.); Bowdon (Tp.); Stockport, n.c. (J.)

F.—Holywell (*W.L.*); Rhyl, o. (Pe.)

D.—Colwyn Bay (*W.L.*)

Car.—Abersoch, c. (Da.)

112. **A. ditrapezium,** Bkh. The only record is in *Zoologist*, Vol. XIX., p. 7536. "Conway (Carnarvonshire), exhibited at meeting of Northern Entomological Society, March 16th, 1861."

113. **A. xanthographa,** F. Abundant throughout.

114. **A. umbrosa,** Hb. Not generally distributed and rather local.

C.—Bowdon, n.c. (*E.L.*); Wallasey, c. at sugar 1899 and 1900 (H., Ta., M.); ditto, on ragwort bloom (Pr., Cr., J., Da.); Oxton (W.G., Sh.); Chester, at e.l. (N.); near Chester, c. (A.); Ince (N.); Vicar's Cross, v.c. (P.C.); Edge, near Malpas, c. at light and treacle (F.H.W.D.); Delamere (N.)

F.—Rhyl, one (Pe.)

Car.—Penmaenmawr (Po.)

115. **A. rubi**, View. Fairly common and widely distributed.

C.—Wallasey, at sugar, c. 1898 and 1900 (H., Pr., M.); Bebington (Sh.); Ince Marshes (N.); Chester, v.c. at e.l. (Do.); ditto, at flowers of hogweed (A.); Vicar's Cross, v.c. (P.C.); Edge, near Malpas, c. (F.H.W.D.); White Hall, near Tarporley (Stk.); Delamere (H., Sh., Da.); Rudheath (Da.); Dunham (Ta.)

F.—Overton and Rhyl, m.c. (Pe.)

D.—Colwyn Bay (N.)

Car.—Deganwy (W.G.); on coast 1900 (J.)

116. **A. dahlii,** Hb. Local and recorded only from Cheshire and Carnarvonshire. It is plentiful some years in Delamere Forest.

C.—Alderley, r.; Hargreave Hall and Hooton; Staley Brushes, n.c. (*E.L.*); Bowdon, r. (Tp.); Delamere, c. (Da., Cr., Ta.); ditto, sugar 1898 (H., M., J.); White Hall, near Tarporley (Stk.)

Car.—Near Conway (W.G.)

117. **A. brunnea,** F. Very general.

C.—Scarce—Bidston, Rock Ferry, Burton (*W.L.*); Wallasey, n.c. (Pr.); Delamere, c. (Ta., Da., H.); ditto, l., c. (J., M., Co.); White Hall, near Tarporley (Stk.); Bowdon, c. (Tp.); Stockport, l., c. (J.); Macclesfield (R. South).

F.—Holywell, Loggerheads (*W.L.*)

Car.—Llanfairfechan (Ta.)

118. **A. primulæ,** Esp. = **festiva,** Hb. Common and generally distributed.

C.—Prenton, Bidston, and Burton (Sh.); Bidston (Pr.); Ince Marshes (N.); Chester, at e.l. (Do.); ditto, v.c. at hogweed flowers (A.); Delamere, c., recorded by all the local collectors; Holford Moss, a. (Da.); Bowdon (Tp.); White Hall, near Tarporley (Stk.); Stockport, f.c. (J.)

F.—Overton and Rhyl, c. (Pe.)

D.—Colwyn Bay (N.)

119. **A. depuncta,** L. Recorded only from one locality, viz.: Staley Brushes (Cheshire, E.), where it is rare (J. Chappell in *E.L.*)

120. **A. glareosa,** Esp. Local and somewhat uncommon, except in Delamere Forest, where it is plentiful in some years.

C.—Ness, s. (*W.L.*); Alderley, r., Dunham Park, Staley Brushes, and Storeton (*E.L.*); Chester, at e.l. (Do., N., A.); Delamere (Da., Tp., J., M., Ta., Cr., H.); Kennel Wood, Sandiway, l. on bramble, June (Co.); White Hall, near Tarporley (Stk.); Macclesfield (R. South).

F.—Loggerheads (*W.L.*)

D.—Colwyn Bay (N.)

Car.—Near Conway (W.G.)

121. **A. plecta,** L. Common throughout, including Anglesea.

122. **A. simulans,** Hufn. = **pyrophila,** F. Very scarce.

C.—Bidston (C. S. Gregson in *E.L.*); Wallasey sandhills, one (W. Johnson in *E.L.*)

F.—Holywell and Loggerheads (*W.L.*)

D.—Near Llangollen (W.G.)

123. **A. lucernea,** L. Local, and restricted in its range; found generally in the same places as *A. ashworthii.*

F.—Loggerheads (*W.L.*, A.); near Llanferres, near Mold (W.G.); the Leet, near Mold; also l. (A.)

D.—Llangollen (B.); Eglwysegs, near Llangollen (W.G., A.)

Car.—Penmaenmawr, c. on the mountains (Po.); ditto, l., sp. (Ta.); mountains near Conway (W.G.)

124. **A. puta,** Hb. Of very infrequent occurrence.

C.—Near Wallasey, one specimen; Storeton Wood (*W.L.*); White Hall, near Tarporley (Stk.)

F.—Rhyl, one (Pe.)

D.—Vale of Clwyd (W.G.)

125. **A. putris,** L. Widely distributed but not common generally.

C.—Ince Marshes, s. (N.); Oxton and Bebington (Sh.); Wallasey, at sugar (Pr.); Chester, c. at e.l. (Do., N., A.); Vicar's Cross (P.C.); Delamere, s. (Ta.); ditto, c. at sugar (H.); pupæ at roots of elm, Daresbury (Co.); White Hall, near Tarporley (Stk.); Carrington Moss (M.); Ashton-on-Mersey (Da.); Dunham, c. in 1899 (Ta.)

F.—Overton, o. (Pe.)

D.—Colwyn Bay (N.)

Car.—Deganwy (W.G.); Abersoch, n.c. (Da.)

126. **A. cinerea,** Hb. Recorded only from Llangollen (Denbighshire) by Mr. F. Birch.

127. **A. exclamationis,** L. Exceedingly abundant throughout.

128. **A. ripæ,** Hb. Local. Rare, except on south coast of Carnarvonshire.

C.—Runcorn (Gregson and Melvill in *E.L.*)

F.—Rhyl, sugar 1857 (*W.L.*); ditto, one (Pe.)

Car.—Abersoch, fairly plentiful (Da., A.); ditto, c. at sugar 1900 (J.)

129. **A. cursoria,** Hufn. Local and confined to the coasts.

C.—Wallasey sandhills; Denhall, one (*W.L.*); Wallasey (Cr., H., J., Ta., Co., M.); ditto, at sugar freely (Pr.)

Car.—Mouth of River Conway (*W.L.*, W.G.); Deganwy (W.G.); Pwllheli, one (N.)

Ang.—Lligwy (Ld. B.)

130. **A. nigricans,** L. Not uncommon in Cheshire on coast sandhills, and mosses. The forms are very dark.

C.—Wallasey sandhills and Denhall (*W.L.*); Wallasey (Pr., H., M., J., Ta.); Chester, at e.l. (Do., A.); White Hall, near Tarporley (Stk.); Vicar's Cross, two (P.C.); Bowdon (Tp.)

F.—Rhyl, one (Pe.)

131. **A. tritici,** L. Common on the Cheshire Coast sandhills and in endless variety. Widely distributed along the coast of the district, and occasionally occurs inland.

C.—Wallasey, Chester, and Denhall (*W.L.*); Wallasey, a. at sugar (H., J., Ta., M.); ditto, at ragwort flowers (Pr., Cr.); Chester (N.); ditto, at e.l. (Do., A.); Ince Marshes (N.); Beeston Hill (A.); Delamere, one (Da.); Bowdon (Tp.)

F.—Rhyl (*W.L.*, W.G.); ditto, c. (Pe.)

D.—Colwyn Bay (N.)

Car.—Llandudno, c. (Pe.); Conway mouth (W.G.); Abersoch, n.c. (Da.)

131a. „ **var. aquilina,** Hb. Not so common.

C.—Wallasey sandhills, o., Denhall, s. (*W.L.*); White Hall, near Tarporley, several (Stk.)

132. **A. obelisca,** Hb. Of very rare occurrence.

C.—Wallasey sandhills, s. (N. Cooke in *W.L.*); Heswall, one in 1884 (Mr. Wilding in *E.L.*)

Car.—Pwllheli, one (N.)

133. **A. corticea,** Hb. Found occasionally on the coast, but very rarely elsewhere.

C.—Wallasey (*W.L.*); ditto, at sugar, o. (J., Pr., M.); ditto, recorded as abundant in 1862 by E. Birchall in *Zoologist*, Vol. XIX., p. 8203.

F.—Holywell (*W.L.*)

D.—Colwyn (*W.L.*); Llangollen Valley (T. S. Ashworth in *Zoologist*, Vol. XIII. (1855).

Car.—Abersoch, n.c. (Da.)

134. **A. ypsilon**, Rott. = **suffusa,** Hb. Widely distributed, though not found in any great numbers except on the coast.

C.—Wirral (*W.L.*, J., Pr., M.); Chester, sugar and at e.l., n.c. (A., Do.); Ince Marshes, one (N.); Vicar's Cross (P.C.); Delamere (J., Sh.); White Hall, near Tarporley (Stk.); Bowdon (Tp.); Dunham (Ta.); Ashton-on-Mersey (Stb., Da.); Stockport (J.)

F.—Holywell (*W.L.*); Mostyn (N.); Rhyl (W.G.); ditto, o. (Pe.)

D.—Colwyn (*W.L.*); Llandulas (Sh.)

Car.—Abersoch (Da.)

135. **A. segetum,** Schiff. Very common throughout.

136. **A. trux,** Hb. **Var. lunigera,** Stph. Local and rare, except on the south coast of Carnarvonshire, where it has been taken fairly plentifully.

C.—Chester, one at e.l. 1899 (Do.)

Car.—Llandudno, one (*W.L.*); Abersoch, generally c. (Da.); ditto, at sugar (A.)

Ang.—Bull Bay and Puffin Island (N.)

137. **A. saucia,** Hb. Widely distributed, though somewhat local and rarely met with in any great numbers.

C.—Bidston, Upton Valley, Eastham Wood, Ness (*W.L.*); Wallasey (*E.L.*); ditto 1899 (H.); Chester, at e.l., one (Do.); ditto, one (A.); Delamere 1900 (H.); ditto, n.u. (Da.); Knutsford, s. (Da.); Bowdon (Tp.); Dunham, one 1900 (Ta.); Alderley, r., and Staley Brushes (*E.L.*); Stockport (J., M.)

F.—Overton, o. (Pe.); Rhyl (W.G.)

D.—Colwyn (*W.L.*)

Car.—Abersoch, c. (Da.)

138. **A. vestigialis,** Rott. = **valligera,** Hb. Common generally, along the coast line. The only inland locality recorded is White Hall, near Tarporley. The specimens taken there are very dark.

C.—Wallasey sandhills, a. at sugar and ragwort flowers (Pr. and others); White Hall, near Tarporley, n.u. at e.l. (Stk.)

F.—Rhyl (*W.L.*, Pe., W.G.)

D.—Colwyn Bay (N.)

Car.—Llandudno (*W.L.*); Conway and Deganwy, a. (W.G.); Abersoch, c. (Da.)

Ang.—Puffin Island (N.)

139. **A. præcox,** L. Very local.

C.—Wallasey—recorded by most of the local collectors—less common now than formerly; Little Meols sandhills (W.G.); Chester, one at e.l. 1899 (Do.); White Hall, near Tarporley, two at e.l. (Stk.); Altrincham—probably brought by excursionists from Southport or Blackpool (Tp.)

Car.—Near Conway (W.G.)

140. **A. prasina,** F. = **herbida,** Hb. Local; and of rare occurrence.

C.—Ledsham (*W.L.*); Delamere (M.); Hale, at sugar (Tp.)

F.—Loggerheads (*W.L.*); Rhyl, one (Pe.)

D.—Colwyn, one in 1884 (*W.L.*)

Car.—Bettws-y-Coed (Bl.); ditto, one (Pe.); near Deganwy (W.G.)

141. **A. occulta,** L. Of very rare occurrence.

C.—Claughton; Denhall, r.; Delamere (*W.L.*); Chester, one at e.l. 1900, by Mr. W. Hargreaves, "Private Secretary" Company (A.); o. "in Cheshire," four miles from Hulme (J. B. Hodgkinson, *Zoologist* Series 1, Vol. III., 1845, p. 1085).

PACHNOBIA, Gn.

142. **P. rubricosa,** F. Generally distributed; and fairly common.

C.—Wirral (*W.L.*); Wallasey sandhills, Eastham Wood, Bowdon, Staley Brushes, Marple (*E.L.*); near Chester (A.); Chester, at light, and Ince Marshes (N.); Delamere, c. (H., M.); White Hall, near Tarporley (Stk.); Tabley and Knutsford, c. (Da.); Stretton Moss, c. (Co.); Stockport (J.); ditto and Gatley (M.); Cheadle and Dunham (Ta.)

F.—Bagillt (*W.L.*)

D.—Bathafarn (*W.L.*); Colwyn Bay (N.)

CHARÆAS, Stph.

143. **C. graminis,** L. Distributed throughout—in some places very abundant. Recorded from all the counties.

EPINEURONIA, Rbl. = NEURONIA, Hb.

144. **E. popularis,** F. Recorded throughout—generally very common.

145. **E. cespitis,** F. Rather local but widely distributed. Found plentifully in some places.

C.—Wallasey (*W.L.*); ditto (J., M., Da.); ditto and Bidston Hill, v.c. as l., but often ichneumoned (Pr.); Bowdon, c. (Tp., Da.); Delamere (Cr., Da.); Knutsford (Da.); Chester, one at e.l. 1898 (Do.); ditto, sp. and at sugar (A.); Edge, near Malpas, f.c. at light (F.H.W.D.)

F.—Rhyl, one (Pe.)

Car.—Abersoch, c. (Da.); Deganwy (W.G.)

Ang.—Lligwy (Ld. B.)

MAMESTRA, Hb.

146. **M. advena,** F. Local and uncommon.

F.—Holywell and Loggerheads (*W.L.*)

D.—Bathafarn and Colwyn (*W.L.*); Colwyn Bay (N.)

Car.—Abersoch (Da.); Deganwy (W.G.)

147. **M. nebulosa,** Hufn. Common and generally distributed. A dark form—the upper wings entirely black with light fringes—occurs in one part of the Delamere Forest district. This variety was first described by Mr. Joseph Collins, of Warrington, who gave it the name of *Robsoni*

C.—Bromborough, Eastham Wood, Ledsham, Delamere (*W.L.*); Delamere (Thompson); ditto, with **var. Robsoni** (Co., Th., H., Cr., J., Ta., M., A., Da.); Holford Moss, c. with o. **var. Robsoni** (Da.): Hale (Tp.); Bidston, c. (Pr.)

F.—Holywell and Loggerheads (*W.L.*); Rhyl, one (Pe.)

D.—Llandulas (P.C.); Colwyn Bay (N.)

Car.—Bettws-y-coed, one, pale as *Chi* (Pe.); Llanfairfechan, pale form (A.)

148. **M. brassicæ,** L. Very common everywhere.

149. **M. persicariæ,** L. Somewhat local and not common generally.

C.—Wallasey, n.v.c. (Pr.); Chester, n.u. at e.l. (Do., A.); ditto and Delamere, l. on ferns (N.); Vicar's Cross (P.C.); White Hall, near Tarporley (Stk.); Knutsford and Holford Moss, o. (Da.); Dunham, r. (Ta., Tp.); Ashton-on-Mersey, c. (Da.)

F.—Near Holywell, l., c. on *pteris aquilina* (*W.L.*)

Car.—Near Conway (W.G.)

150. **M. albicolon,** Hb. Common on some parts of the coast; not taken inland.

C.—Wallasey sandhills, c., recorded by all the local collectors.

F.—Rhyl (*W.L.*); ditto, s. (Pe.)

Car.—Abersoch, c. (J., A., Da.); Deganwy (W.G.)

Ang.—Puffin Island (N.); near Holyhead (R. Freer).

151. **M. oleracea,** L. Common everywhere.

152. **M. genistæ,** Bkh. Larvæ found on broom at Moore Station (Cheshire) by Mr. E. C. Buxton (*E.L.*) Four or five taken at e.l., White Hall, near Tarporley, about 1900, by Mr. J. H. Stock.

153. **M. dissimilis,** Knoch. = **suasa,** Bkh. Not general; and not plentiful where it does occur.

C.—Wallasey, Bidston Marsh, s., more frequent at Denhall (*W.L.*); Chester, at sugar (A.); ditto, at e.l., n.c. (Do.); Holford Moss, m.c. (Da.); Altrincham (*E.L.*); Dunham, r. (Ta.); Ashton-on-Mersey (Stb.)

F.—Holywell (*W.L.*); Overton, o. (Pe.)

154. **M. thalassina,** Rott. Common generally. Recorded from all the counties except Anglesea.

155. **M. contigua,** Vill. Of very rare occurrence.

C.—Rock Ferry, one 1860 (*W.L.*)

D.—Colwyn Bay (N.)

Car.—Abersoch, at sugar (A.)

156. **M. pisi,** L. Common generally.

C.—Generally distributed; most frequently found in l. state (Da,); New Ferry, a. (*W.L.*); Wallasey (Pr.); Delamere (Cr., H., J., M.); Ince Marshes (N.); White Hall, near Tarporley (Stk.); Hale (Tp.); Ashton-on-Mersey (Stb.); Stockport, l. (J.); Oxton and Prenton (Sh.)

F.—Loggerheads, Rhyl, Holywell, l., a. on willows near Bagillt (*W.L.*); Prestatyn (N.)

Car.—Capel Curig, Deganwy, and Carnarvonshire Mountains, v.a. (W .G.)

157. **M. trifolii,** Rott. = **chenopodii,** F. Extremely rare.

C.—Denhall, one in 1870 (*W.L.*); Macclesfield (R. South).

158. **M. glauca,** Hb. Recorded solely from Cheshire, where it is found only very occasionally.

C.—Delamere (*W.L.*); ditto, one (Da.); ditto (Ta.); ditto, l., o. on birch (A.); N. Cheshire (N.G.); Lindow Common, Staley Brushes, and Storeton (*E.L.*)

159. **M. dentina,** Esp. Widely distributed and common generally.

C.—Moderately common throughout the county.

F.—Llyn Helig and Loggerheads (*W.L.*); Overton, m.c. (Pe.)

D.—Bathafarn, Colwyn (*W.L.*); Colwyn, apparently s. (N.)

Car.—Abersoch, a.—v.c. and varied in 1900 (J., Da.)

Ang.—Near Holyhead 1900 (R. Freer).

160. **M. reticulata,** Vill. = **saponariæ,** Bkh. Of very rare occurrence.

C.—Denhall, s., Delamere (*W.L.*); Chester, at e.l., one in 1899 and one in 1900 (Do.); White Hall, near Tarporley, one 1901 (Stk.)

F.—Overton and Rhyl, s. (Pe.)

D.—Llangollen Valley (T. S. Ashworth in *Zoologist*, Vol. XIII., 1855).

161. **M. serena,** F. Local but widely distributed. Found most plentifully on the coasts.

C.—Ness, Burton, Capenhurst (*W.L.*); Wallasey, one 1900 (H.); ditto, o. at sugar (J., M.); ditto, n.u on posts, sugar, &c.—l. on *hieracium* flowers (Pr.); Oxton (Sh.); Sealand and Saltney (Thompson); Chester, n.u. at e.l. (Do.); Helsby (A.); White Hall, near Tarporley, a few at e.l. (Stk.)

F.—Loggerheads, Holywell, and Rhyl (*W.L.*); Rhyl, m.c. (Pe.)

D.—Vale of Clwyd (W.G.); Llandulas (Sh); Colwyn Bay, one 1898 (Do.); ditto and district, o.; also Abergele (N.)

Car.—Llandudno (*W.L.*); Abersoch, n.u. 1900 (J., Da.); near Conway (W.G.)

Ang.—Near Holyhead 1900 (R. Freer).

DIANTHŒCIA, B.

162. **D. luteago,** Hb. **Var. barrettii,** Dbld. Recorded from Carnarvonshire only (taken 1897 and 1899) by Mr. F. C. Woodforde (*Ent.* XXXII., p. 254).

163. **D. nana,** Rott. = **conspersa,** Esp. Local and seldom met with.

C.—Tranmere, one by Mr. Warrington (*W.L.*); s., Marple and West Kirby (*E.L.*)

Car.—Abersoch, c. (Da.); Criccieth (W.G.); Penmaen Bach, near Conway (W.G.)

Ang.—Near Holyhead (R. Freer—*E.M.M.*, Vol. XII., p. 13).

164. **D. capsincola,** Hb. Common and widely distributed.

C.—Wirral (*W.L.*); Wallasey (Pr.); near Chester, l. plentiful, but infested with the ichneumon *O. luteum* (A.); ditto, c. at e.l. (A.); Kingsley, l. (Co.); Delamere, l., c. (H., A.); ditto and Knutsford, o. (Da.); White Hall, near Tarporley (Stk.); Dunham (Tp.); Stockport, l., c.; imago not often seen (J.); Macclesfield (R. South).

F.—Holywell, l., c. (*W.L.*); Overton, o., and Rhyl, v.c. (Pe.)

D.—Vale of Clwyd (W.G.); Colwyn Bay (N.)

Car.—Deganwy (W.G.); Abersoch, c. (Da.); on the coast in 1900 with l. (J.)

Ang.—Near Holyhead (R. Freer—*E.M.M.*, Vol. XII., p. 13).

165. **D. cucubali,** Fuessl. Widely distributed and not uncommon.

C.—Wallasey and Puddington, s. (*W.L.*); Wallasey, n.c. (Pr.); Chester, n.u. at e.l. (Do.); near ditto, l., s., (A.); commoner than the preceding species in the Chester district (N.); White Hall, near Tarporley (Stk.); Knutsford and Holford Moss, n.u. (Da.); Stockport, l.c. (J.)

F.—Larvæ in campion pods, s. (A.)

D.—Colwyn Bay (*W.L.*); ditto, f.c. (N.)

Car.—Larvæ, c. on coast in 1900 (J.)

166. **D. carpophaga,** Bkh. Decidedly scarce.

C.—Denhall, r., s. (*W.L.*); West Kirby (Gregson in *E.L.*); Stockport, one (J.)

F.—Holywell, l., and Northop (*W.L.*); Cwm, o. (Pe.); near Halkyn (W.G.); recorded for the county by H. Harper Crewe in *Zoologist*, Vol. XII. (1854), p. 4192.

BOMBYCIA, Stph. = CLEOCERIS, B.

167. **B. viminalis,** F. Very rarely taken.

C.—Shavington Park, borders of Cheshire and Salop, l. (Th.); Wallasey, one 1899 (H.); Dane's Moss, Macclesfield, l. (R. South—*Ent.* XXVIII., p. 270); Great Budworth, dark form from l. found 1901 (Miss Roscoe).

F.—Loggerheads (*W.L.*)

MIANA, Stph.

168. **M. literosa,** Hw. Common generally on the coast; more scarce inland.

C.—Wallasey, c. (Pr., J., M.); ditto and Delamere, c. (H.); Chester, c. at e.l. (Do., A., N.); Vicar's Cross, f.c. (P.C.); Helsby, f.c. (N.); Dunham (Ta.); Warburton (Tp.)

F—Loggerheads (*W.L.*); Rhyl, o. (Pe.)

Car.—Abersoch (Da,); Penmaenmawr (Po.)

Ang.—Puffin Island (N.)

169. **M. strigilis,** Cl. Very common almost everywhere, though there are no records for Anglesea.

170. **M. fasciuncula,** Hw. Common and generally distributed.

C.—Wirral, Chester, c. (*W.L.*); Wallasey (M.); Chester, at e.l. (Do., A.); Bidston and Prenton (Sh.);

Ince Marshes, Helsby, and Delamere (N.); Delamere, c. (H.); Dunham (Ta.); Knutsford, c. (Da.)

F.—Loggerheads (*W.L.*); Overton and Rhyl, o. (Pe.)

D.—Colwyn (*W.L.*)

Car.—Deganwy (W.G.)

171. **M. bicoloria,** Vill. = **furuncula,** Tr. More restricted in its distribution than the last species.

C.—Wallasey, Ness, Burton, and Chester (*W.L.*); Wallasey (Pr., H.); Delamere (H.); Chester, at e.l. (Do., N., A.); Walton, c. (Co.)

F.—Overton, Cwm, and Rhyl, v.c. (Pe.)

BRYOPHILA, Tr.

172. **B. algæ,** Fab. "In the collection of the late Joseph Sidebottom are two specimens of this species captured at Disley (Cheshire), and obtained by him from Mr. R. S. Edelston's collection" (*E.L.*) Mr. C. G. Barrett remarks in his *Lepidoptera of the British Isles*, Vol. VI., p. 214:—"No other case of the occurrence of the species in these Islands is known, and it can only be supposed that these two specimens were by some accidental means introduced."

173. **B. perla,** F. Common throughout.

C.—Wirral, Chester City Walls (*W.L.*); ditto and at e.l. (A.); ditto, south side, v.c. (N., Do.); Wirral, on old walls (W.G.); Wallasey (Pr., M., J.); Bidston (Pr.); Oxton (Sh.); Hoylake, where there is an ochreous form (A.); West Kirby (Da.); Delamere (A., Da., Ta., H.); Bowdon (Tp.); Stockport and Whaley Bridge (J.); Macclesfield, n.c. (R. South).

F.—Bagillt (*W.L.*); Rhyl, v.c. (Pe.)

D.—Vale of Clwyd, a. (W.G.)

Car.—Llanfairfechan (A.); Penmaenmawr (Po.); near Conway, a. and on mountains of the county (W.G.); Abersoch (Da.)

Ang.—Beaumaris Castle (A.)

DILOBA, B.

174. **D. cæruleocephala,** L. Appears to be widely distributed.

C.—Seldom met with (Da.); Chester, at e.l., several (Do.); ditto, c. (N., A.); Bidston and Puddington, s. (*W.L.*); White Hall, near Tarporley, two (Stk.); Knutsford, one l. 1902 (Miss Roscoe); ditto, two at light 1902 (Da.); Ashley and Delamere (Tp.)

F.—Overton, Cwm, and Rhyl, c. (Pe.)

D.—Llandulas, l., v.c. (P.C.); Colwyn Bay, l. (N.); Vale of Clwyd (W.G.); Ruthin (Allen in *Ent. Rec.* III., p. 15.)

Car.—Conway Valley, l., v.c. (Bl.); near Conway (W.G.)

APAMEA, Tr.

175. **A. testacea,** Hb. Common and generally distributed; recorded from all the counties except Anglesea.

CELÆNA, Stph.

176. **C. haworthii,** Curt. Found only on moors and mosses.

C.—Carrington Moss, now s. (Da.); Whitegate Heath (Co.); Delamere (N.); Wybunbury Bog (Th., F. C. Woodforde); Dane's Moss, Macclesfield (R. South, *Ent.* XXVIII., p. 269).

D.—Gwern; Minera, near Wrexham 1859 (*W.L.*)

177. **C. matura,** Hufn. = **cytherea,** F. Local, but widely distributed and common where it occurs.

C.—Wirral (*W.L.*); Oxton and Noctorum (Sh.); Newton-cum-Larton (Da.); Wallasey, c. at sugar (Pr., H.); Chester (N., A.); ditto, n.u. at e.l. (Do.)

F.—Rhyl, o. at light (Pe.); Nant-y-ffrith Valley (N.)

D.—Llangollen Valley (T. S. Ashworth in *Zoologist*, Vol. XIII., 1855).

Car.—Deganwy (W.G.)

HADENA, Schrk.

178. **H. adusta,** Esp. Somewhat local and not common generally.

C.—Wallasey and Puddington (*W.L.*); Wallasey, o. (J.); Hoylake, c. (Pr.); Delamere o. (J.); ditto, l. plentiful on sweetgale (A.); Dunham, c. (Ta.); Ashton-on-Mersey (Stb., Da.); Holford Moss, m.c. (Da.); Macclesfield (R. South).

F.—Loggerheads (*W.L.*); Nant-y-ffrith and district, apparently c. (N.)

Car.—Near Conway (W.G.)

179. **H. furva,** Hb. Uncommon.

C.—Very rare. Chester, one at sugar (A.); Ince Marshes, one (N.); "under sods" at Stockport, June 22nd, 1844 (R. S. Edelston in *Zoologist*, Vol. II., pp. 734 and 735).

F.—Loggerheads (*W.L.*)

D.—Eglwysegs, near Llangollen (W.G.); Llangollen Valley (T. S. Ashworth in *Zoologist*, Vol. XIII., 1855).

Car.—Orme's Head (*W.L.*, W.G.); Penmaenmawr, n.r. at sugar (Ta.); Dwygyfylchi 1902 (Da.)

180. **H. sordida,** Bkh. = **anceps,** Hb. Not at all general.

C.—Wirral (*W.L.*); Wallasey, at sugar, n.v.c. (Pr.); Bidston (Sh.); Chester, at e.l., n.u. (Do., A.); ditto, at flowers of hogweed (A.); Holford Moss, n.u. (Da.)

F.—Holywell (*W.L.*)

D.—Colwyn (*W.L.*)

181. **H. monoglypha,** Hufn. = **polyodon,** L. Abundant everywhere. The black form, *ab. infuscata*, Buchanan-White, taken occasionally at Chester (*W.L.*)

182. **H. abjecta,** Hb. Of very rare occurrence.

C.—Claughton, Ness, and Puddington, s. (*W.L.*); New Brighton, two at sugar 1852 (G. A. Almond in *Zoologist*, Vol. II., p. 3776).

F.—Bagillt and Holywell (*W.L.*); Overton, s. (Pe.)

D.—Eglwysegs, near Llangollen (W.G.)

183. **H. lithoxylea,** F. Common and generally distributed.

C.—Common throughout.

F.—Rhyl (Pe.)

D.—Colwyn Bay (N.)

Car.—Abersoch, c. (Da.)

184. **H. rurea,** F. Very common throughout. The variety **alopecurus,** Esp. = **combusta,** Dup. is as numerous as the type.

185. **H. hepatica,** Hb. Rare.

C.—Puddington (*W.L.*); Cotteril Clough (*E.L.*); Ledsham (Sh.); Chester, at gas lamps and sugar, o. (A.); Ince Marshes, s. (N.); Little Budworth, at light (N.); Hale, at sugar (Tp.); Delamere, f.c. in 1898 and 1900 (H.)

F.—Holywell, c. (*W.L.*); Overton and Rhyl, o. (Pe.)

D.—Colwyn Bay (N.)

186. **H. scolopacina,** Esp. Exceedingly scarce.

C.—Chester, at e.l., r. (A.); Edge, near Malpas, one at sugar (F.H.W.D.); Stockport, one 1902 (J.)

187. **H. basilinea,** F. Common almost everywhere. Not recorded from Anglesea.

188. **H. gemina,** Hb. Fairly common.

C.—Wallasey (M., J.); ditto, and vars. (Pr.); Bebington and Bidston (Sh.); Ince Marshes (N.); Chester, at e.l. (Do.); ditto, on hogweed flowers (A.); White Hall, near Tarporley (Stk.); Delamere 1898 (H.); Knutsford and Holford Moss (Da.); Dunham (Ta.); Hale (Tp.); Stockport, f.c. and variable (J.)

F.—Overton, Cwm, and Rhyl, c. (Pe.); Nant-y-ffrith Valley (N.)

D.—Colwyn Bay (N.)

189. **H. unanimis,** Tr. Rather local and not generally distributed, though fairly plentiful where found.

C.—Wallasey, Rock Ferry, and Puddington (*W.L.*); Prenton and Alderley (*E.L.*); Oxton (Sh.); near Chester, c. (N.); ditto, about wet ditches (A.); ditto, at e.l. (Do.); Holford Moss, near Knutsford, c. (Da.); Ashton-on-Mersey, c. (Stb., Da.); Dunham (Ta.); Hale (Tp.); Thelwall and Moore (Co.)

F.—Loggerheads (*W.L.*)

190. **H. secalis,** L. = **didyma,** Esp. and **oculea,** Gn. Abundant everywhere throughout. Very variable.

APOROPHYLA, Gn.

191. **A. lutulenta,** Bkh. Local and met with sparingly in Cheshire. Common in South Carnarvonshire.

C.—Wirral, Chester, s. (*W.L.*); n.c., Eastham Wood and Wallasey (*E.L.*); Leasowe, v.s. (Pr.); Chester, s. at sugar, several at e.l. (A.); ditto, one (Do.); Delamere (Ta., M.); ditto, sp. (Da.); ditto, odd specimens (J.)

Car.—Abersoch, c. (Da.); near Deganwy and Conway (W.G.)

192. **A. nigra,** Hw. Only three localities recorded in the district.

C.—Chester, one at e.l. 1898 (Do.)

D.—Nant-y-Glyn, Colwyn, a. at sugar and *arbutus* flowers (*W.L.*)

Car.—Abersoch, c. (Da.)

EPUNDA, Gn.

193. **E. lichenea,** Hb. Fairly plentiful where it occurs, but the localities in the district are few and chiefly on the coast.

C.—Wallasey and Bidston (*W.L.*); Wallasey (Ta., M.); ditto, l., also imago at light (Pr.); ditto, f.c. at sugar 1899, two in 1900 (H.); Hoylake and West Kirby (W.G.); Ledsham (Sh.); nearly 100 taken at New Brighton (S. Robson in *Zoologist*, Ser. 1, Vol. VIII. (1850), p. 2958).

F.—Llanferres, near Mold (B.); near Rhyl and inland (W.G.); Overton, o. (Pe.)

Car.—Near Conway (W.G.); Llanfairfechan (Ta.); Abersoch, f.p. at ivy broom (Da.)

POLIA, Tr.

194. **P. chi,** L. Somewhat local, but common and widely distributed.

C.—Bidston, Ness, Burton, and Puddington (*W.L.*); Noctorum, s. (Pr.); Chester, at e.l., with one **var. olivacea** (Do.); Delamere, n.c. (Da., H.); Tarporley, sp. (Stk., Da.); Edge, near Malpas, c. on the trunks, with **var. olivacea** (F.H.W.D.); Stockport, f.c. (J.); Whaley Bridge and district, v.c. on stone walls (J., Da.); Stalybridge, c. (Tp.); Macclesfield (R. South); Beeston Castle walls (A., N.); "Cheshire," **var. olivacea** (Fremlin in *Ent.* XXVIII., p. 283).

F.—Loggerheads and Holywell (*W.L.*); Overton, o., and Rhyl, m.c.; "a few have a pretty green tint, though pale and partial" (Pe.); Cilcairn (A.)

D.—Colwyn Bay (N.)

Car.—Conway (W.G.)

Ang.—Lligwy (Ld. B.)

DASYPOLIA, Gn.

195. **D. templi,** Thnb. Rare and local.

C.—Bidston Lighthouse, one (*W.L.*); Chester, e.l., one of each sex (A.); Stalybridge, found by turning over boulders on hillsides (Tp.)

D.—Colwyn Bay, one female (N.)

Ang.—Puffin Island, one (N.)

BRACHIONYCHA, Hb. = ASTEROSCOPUS, B.

196. **B. sphinx,** Hufn. = **cassinea,** Hb. Local and very rarely seen.

C.—North Cheshire (N.G.); Chester, c. in Nov. at gas lamps in Wrexham Road (A.); ditto, one at e.l. 1898 (Do.)

D.—Colwyn Bay (N.)

MISELIA, O.

197. **M. oxyacanthæ,** L. Common and generally distributed.

C.—Common throughout. The **var. capucina,** Mill., recorded from Ashton-on-Mersey (Da.); and Stockport (J.)

F.—Overton, c., Rhyl, m.c., and Cwm, o. (Pe.)

D.—Colwyn Bay (N.)

DICHONIA, Hb.

198. **D. aprilina,** L. Generally distributed, but not found plentifully except in such places as Delamere Forest.

C.—Bidston, Rock Ferry, Eastham, Ness, and Puddington, n.v.c. (*W.L.*); near Eccleston, o. (Da.); Chester, at sugar (A.); Delamere, c. (Da., M., Cr., A., J., Ta.); White Hall, near Tarporley (Stk.); Pettypool Park, pupæ (Co.); Knutsford and Dunham Park, o. (Da.); ditto, c. (Tp.); Stockport (J.); Edge, near Malpas (F.H.W.D.); Goostrey 1901 (Da.); Bidston, o. (Pr.); Macclesfield (R. South).

F.—Holywell (*W.L.*); Overton and Cwm, c. (Pe.); Halkyn (W.G.)

D.—Colwyn and Llangollen (*W.L.*)

Car.—Near Conway (W.G.)

DRYOBOTA, Ld.

199. **D. protea,** Bkh. Somewhat local, but often plentiful where oaks abound.

C.—Rock Ferry and Puddington (*W.L.*); Oxton (Sh.); Storeton, n.c. (Pr.); Delamere, recorded as a. by all the local collectors; Chester (A.); Vicar's Cross (P.C.); Ince Marshes, s. (N.); White Hall, near Tarporley (Stk.); Knutsford, o. (Da.); Stockport, s. (J.); near Malpas, c. (F.H.W.D.); Bowdon (Tp.)

F.—Holywell (*W.L.*); Overton, m.c., and Rhyl, one (Pe).

DIPTERYGIA, Stph.

200. **D. scabriuscula,** L. = **pinastri,** L. Fairly plentiful where it occurs, but the recorded localities are few and all in Cheshire.

C.—Knutsford, several times, Alderley, c. in 1879 (*E.L.*); Rudheath, near Knutsford 1901 (Da.); Delamere, several at sugar 1898 and 1900 (H.); Kennel Wood, Sandiway 1899 (Co.); ditto, 1899 and 1902 (Da.); White Hall, near Tarporley (Stk.); Little Budworth, at light (N.); Congleton (Stb.)

EUPLEXIA, Stph.

201. **E. lucipara,** L. Widely distributed and generally very abundant. No records for Anglesea, though it doubtless occurs there.

BROTOLOMIA, Ld.

202. **B. meticulosa,** L. Very common. Recorded from all the counties.

MANIA, Tr.

203. **M. maura,** L. Common and generally distributed.

C.—Occurs throughout the county.

F.—Overton and Rhyl, m.c. (Pe.)

D.—Valle Crucis, near Llangollen (B.); Vale of Clwyd (W.G.)

Car.—Penmaenmawr (Po.); Deganwy (W.G.); near Beddgelert (B.)

NÆNIA, Stph.

204. **N. typica,** L. Common and generally distributed.

HELOTROPHA, Ld.

205. **H. leucostigma,** Hb. Recorded only from four localities in the district.

C.—Dunham Park and Wallasey sandhills, o. (*E.L.*); White Hall, near Tarporley, one (Stk.)

Car.—Abersoch, c., with **var. fibrosa,** Hb. (Da.)

HYDRŒCIA, Gn.

206. **H. nictitans,** Bkh. Common and generally distributed throughout the district. Very abundant and extremely varied on the coast of Cheshire at Wallasey.

207. **H. micacea,** Esp. Very common. Widely and generally distributed.

C.—Common throughout the county.

F.—Bagillt Hall and Loggerheads (*W.L.*); Rhyl and Overton, v.c. (Pe.)

D.—Colwyn Bay and Abergele (N.)

Car.—Abersoch (Da.); Deganwy (W.G.)

Ang.—Lligwy (Ld. B.)

208. **H. petasitis,** Dbld. Extremely local.

C.—East Cheshire (N. Greening in *W.L.*); seven l. and three pupæ, dug up at Weaverham, 7th Sept, 1850 (N. Cook in *Zoologist*, Ser. 1, Vol. VIII., p, 2932);

Ashley (Tp.); pupæ have been taken in large numbers at Stockport about 1892-5, but they appear to be much less common now (J.); near Walton, very local (Co.); Chester, one at e.l. 1900 (Do.): ditto, one only (A.)

GORTYNA, Hb.

209. **G. ochracea,** Hb. = **flavago,** Esp. Fairly common.

C.—Birkenhead, becoming scarcer (*W.L.*); Wallasey, at sugar and light (Pr.); ditto, pupæ in thistle stems (M.); Flaybrick, pupæ c. in stems of marsh thistle (Pr.); Ledsham (Sh.); Chester, at light (A.); ditto, n.u. at e.l. (Do.); Delamere, l., c. in thistle stems (H.); Ashley, n.u. (Da.); Rostherne (Tp.); Ince, l., c. (N.); White Hall, near Tarporley (Stk.); Edge, near Malpas, c. in larval and pupal stage (F.H.W.D.)

F.—Rhyl, size very variable (Pe.); near Wrexham, a few (N.)

Car.—Deganwy and Conway, a. (W.G.)

NONAGRIA, O.

210. **N. typhæ,** Thnb. = **arundinis,** F. Occurs generally wherever the reedmace *Typha latifolia* grows.

C.—"In pits, wherever reedmace grows in Cheshire, I have always been able to take the pupæ" (Co.); l., v.c. in stems of *Typha latifolia*, in pits, wet ditches, &c. (Pr.); Ince Marshes, c., also freely in pits neighbourhood of Chester (N.); Chester, v.c. at e.l. (Do., A.); Edge, near Malpas, c. in l. and pupal state (F.H.W.D.); Wybunbury Moss (F. C. Woodforde); Delamere, pupæ (M.); Knutsford and Tabley, c. (Da.)

CŒNOBIA Stph.

211. **C. rufa,** Hw. Local and rare.

C.—Little Neston and Ledsham (*W.L.*); Ince Marshes, s. (N.); Chester, one at e.l. 1899 (Do.)

F.—Mostyn, a few (N.)

D.—Colwyn Bay (N.)

TAPINOSTOLA, Ld.

212. **T. fulva,** Hb. Generally common in marshy places.

C.—Bidston Marsh, Tranmere, Puddington, Chester, and Hatchmere (*W.L.*); Chester, at e.l. (Do., A.); ditto (B. Tomlin); Knutsford (Da.); Carrington Moss, c. (Stb., Da.); Stockport, c. (J.)

F.—Mostyn (N.); Overton, o. (Pe.)

Car.—Abersoch (Da.); near Llandudno (W.G.)

CALAMIA, Hb.

213. **C. lutosa,** Hb. Local and not generally common.

C.—Bidston Marsh, Burton, Ness, s., Puddington, s. (*W.L.*); throughout Wirral (J. F. Brockholes); Bidston Marsh, n.u., and Wallasey, sugar (Pr.); Chester, at e.l., specially in 1898 (Do.); ditto, sp. (A.)

Car.—Abersoch, c. at sugar 1897 (Da.)

214. **C. phragmitidis,** Hb. Local and uncommon.

C.—The Lead Works, Chester, 11th Aug., 1858 at light (*W.L.*); Chester, one at e.l. 1899 (Do.); ditto and Ince Marshes (N.); Carrington (Stb.); near Walton railway bridge, Warrington, sp.; more abundant on the Lancashire side of Warrington (Co.)

LEUCANIA, Hb.

215. **L. impura,** Hb. Common and generally distributed throughout the district, including Puffin Island, Anglesea (N.)

216. **L. pallens,** L. Common and generally distributed. No Anglesea records.

217. **L. comma,** L. Widely distributed and fairly common.

C.—Wirral, Chester (*W.L.*); Chester, v.c. at e.l. (Do., N., A.); Vicar's Cross (P.C.); Wallasey (J.); ditto, freely to sugar (Pr., M.); Oxton and West Kirby (Sh.); Delamere, c. 1900 (H.); White Hall, near Tarporley, f.c. (Stk.); Holford Moss, c. (Da.)

F.—Holywell and Rhyl (*W.L.*); Overton, one (Pe.)

D.—Colwyn Bay (N.)

Car.—Pwllheli 1895 and coast 1900 (J.); Abersoch, c. (A., Da.)

218. **L. littoralis,** Curt. Recorded only from the coast, but is generally plentiful where found.

C.—Wallasey sandhills (*W.L.*); ditto, Meols and Hoylake sandhills, frequent as l. crawling in the grass (W.G.); Wallasey (J., Cr., Pr., Ta., M., Co., Sh.)

F.—Rhyl (*W.L.*, Pe., W.G.)

Car.—Deganwy (W.G.); Pwllheli 1895 (J.); Abersoch, c. at sugar (Da., A.); ditto 1900 (J.)

219. **L. unipuncta,** Hw. = **extranea,** Gn. One specimen captured at sugar 1897, in South Carnarvonshire, by G. O. Day.

220. **L. conigera,** F. Recorded locally throughout the district. Fairly common in some parts.

C.—Ness and Rock Ferry (G. A. Almond in *W.L.*); Bidston (Sh.); Wallasey, r. (M.); ditto, n.v.c. (Pr.); Chester, at light (N.); ditto, c. (Do.); ditto, at e.l. and at sugar (A.); Vicar's Cross, f.c. (P.C.); White Hall, near Tarporley, f.c. (Stk.)

F.—Holywell (Archer in *W.L.*); Minera district (N); Rhyl Coast, c. (W.G.)

D.—Bathafarn and Colwyn (*W.L.*); ditto (N); Trefnant, one (Pe.)

Car.—Abersoch, c. (A., Da.); c. on sandhills near Llandudno (Po.); Conway (W.G.)

Ang.—Puffin Island (N.)

221. **L. lythargyria,** Esp. Widely distributed and fairly common generally. Less common in East Cheshire.

222. **L. turca,** L. Recorded from Dunham Park, Cheshire (rare) by Joseph Chappell in *E.L.*, "confirmed by J. B. Hodgkinson." There are no records in recent years, and it is doubtful if the species exists there now.

STILBIA, Stph.

223. **S. anomala,** Hw. Very rare in Cheshire. Appears to be nowhere plentiful except at Penmaenmawr.

C.—Local, Staley Brushes (*E.L.*); White Hall, near Tarporley, one (Stk.)

F.—Holywell and Talacre (*W.L.*)

D.—Clwyd Hills (W.G.)

Car.—Penmaenmawr, a. on lower mountain slopes (Po., Ta.); Conway mountain and The Rivals (W.G.); Pwllheli, one (N.); Abersoch, n.c. (Da.)

GRAMMESIA, Stph.

224. **G. trigrammica,** Huf. = **trilinea,** Hb. Common and general.

C.—Very common throughout the county; the **var. bilinea**, Hb. frequently occurs also.

F.—Overton, o. (Pe.)

D.—Abergele and Colwyn Bay (N.)

Car.—Deganwy (W.G.); on coast, c. (J.)

CARADRINA, O.

225. **C. exigua,** Hb. Chester, one taken at e.l. 1900, by Dr. Herbert Dobie.

226. **C. quadripunctata,** F. = **cubicularis,** Bkh. Very common throughout.

227. **C. morpheus,** Hufn. Appears to be generally distributed, but is not plentiful as a rule.

C.—Denhall, Wallasey, Delamere, and Chester (*W.L.*); Wallasey, sugar (Pr., H.); Chester, c. at e.l. (Do., A., N.); Ince Marshes (N.); Edge, near Malpas (F.H.W.D.); White Hall, near Tarporley (Stk.); Hale, r. (Tp.); Dunham (Ta.); Ashton-on-Mersey (Stb.); Newton-cum-Larton (Da.); Stockport, a few (J.)

F.—Loggerheads, Bagillt, and Rhyl (*W.L.*); Rhyl and Overton (Pe.)

D.—Colwyn (*W.L.*, N.)

Car.—Deganwy (W.G.)

Ang.—Near Holyhead (R. Freer).

228. **C. alsines,** Brahm. Rather scarce.

C.—Wallasey and Bromborough, s. (*W.L.*); Wallasey, n.c. (Pr., M.); Chester, tolerably c. at e.l. (Do., A.); Hale (Tp.); Ashton-on-Mersey (Stb.)

F.—Overton and Rhyl, o. (Pe.)

D.—Colwyn (*W.L.*)

229. **C. taraxaci,** Hb. = **blanda,** Tr. Not general, though widely distributed and fairly plentiful where found.

C.—Wirral (*W.L.*); Wallasey, c. at sugar (Pr., M.); Chester, f.c. at e.l. (A., Do.); Ince Marshes, one (N.); Delamere, f.c. at sugar 1899 (H.); White Hall, near Tarporley (Stk.)

F.—Loggerheads and Rhyl (*W.L.*); ditto and Overton, c. (Pe.)

D.—Colwyn and Bathafarn, near Ruthin (*W.L.*)

Car.—Abersoch, c. (Da.); Gloddaeth, near Llandudno (W.G.)

PETILAMPA, Auriv.

230. **P. arcuosa,** Hw. Local but generally common where it occurs—on marshy places.

C.—Bidston Marsh and Puddington, s. (*W.L.*); Bidston (Pr.); Bebington (Sh.); Chester, n.u. at e.l. (Do., A.); Knutsford Moor, c. (Da.); Rostherne, s. (Tp.); Macclesfield (R. South).

F.—Holywell (*W.L.*)

RUSINA, Stph.

231. **R. umbratica,** Goeze. = **tenebrosa,** Hb. Somewhat local; often common where it occurs.

C.—Wallasey, Bidston, Ness, and Burton, s. (*W.L.*); Wallasey, freely at sugar (H., Pr., M.); Tranmere (*E.L.*); Chester, at e.l. (Do.); White Hall, near Tarporley (Stk); Delamere 1899 and 1900 (H.); ditto and Holford Moss, c. (Da.); Pettypool Park, at sugar (Co.); Bowdon, s. (Tp.); Dunham (Ta.)

F.—Holywell and Loggerheads (*W.L.*); Cwm, one (Pe.)

D.—Colwyn (*W.L.*); ditto, c. (N.); Llangollen Valley (Ashworth).

AMPHIPYRA, O.

232. **A. tragopoginis,** L. Abundant throughout.

233. **A. pyramidea,** L. Very scarce.

C.—Puddington, one specimen in 1870 (*W.L.*); Dunham Park and Eastham Wood, r. (*E.L.*); Chester, one at gas light 1898 (Do.); ditto s., also at sugar (A); near ditto, s. (N.); Vicar's Cross, one at sugar (P.C.); Edge, near Malpas, f.c. at treacle (F.H.W.D.)

F.—Overton and Rhyl, o. (Pe.)

TÆNIOCAMPA, Gn.

234. **T. gothica,** L. Common and generally distributed throughout.

235. **T. miniosa,** F. Recorded from Delamere Forest (Cheshire) rare, by Mr. Chappell in *E.L.*

236. **T. pulverulenta,** Esp. = **cruda,** Tr. Common generally.

C.—Bidston, n.u. (Pr.); Chester, tolerably c. at e.l. (Do.); near ditto, a. at sallow bloom (A.); Delamere, a. at sallow bloom (H., J., Ta., Da.); Knutsford, a. (Da.); Gatley, near Cheadle (Ta., M.)

F.—Overton, c. (Pe.)

D.—Colwyn Bay (N.)

237. **T. populeti,** Tr. Local and restricted in its distribution.

C.—Wirral, s. but generally distributed (*W.L.*); Eastham and Marple, s. (*E.L.*); Wallasey, v.s. (Pr.); Chester, o. at e.l. (A.); ditto, one 1900 (Do.); near Knutsford, locally c. (Da., J., M.); Mobberley (Tp.)

D.—Rossett (A.)

238. **T. stabilis,** View. Common and generally distributed.

C.—Common almost throughout; not very common at Wallasey (Pr.)

F.—Overton, v.c., and Cwm, c. (Pe.); Mostyn (N.)

D.—Vale of Clwyd (W.G.); Colwyn Bay (N.)

Car.—Deganwy (W.G.)

239. **T. incerta,** Hufn. = **instabilis,** Esp. Common and generally distributed. No records for Anglesea.

240. **T. opima,** Hb. Recorded from practically two localities only, viz.: the north coast of Wirral, and Llandudno, but at the former place it is fairly common.

C.—Leasowe, Bidston (*W.L.*); Wallasey, recorded as abundant by all who have collected there; imagines at sallow blossom and ova on dead thistles, ragwort, &c., in April.

Car.—Llandudno (Tp.)

241. **T. gracilis,** F. Local but widely distributed.

C.—Wirral (*W.L.*); Wallasey (Pr.); Eastham (Sh.); Chester (N.); ditto, at e.l. (Do.); ditto, l. c. on unopened meadowsweet bloom (A.); Edge, near Malpas, one (F.H.W.D.); Delamere, a few at sallow (H.); Knutsford, one (Da.); Hale (Tp.); Gatley, near Cheadle, c. (M., Ta., J., Da.); Lindow Common (*E.L.*); Stretton Moss (Co.)

F.—Marsh land near Bagillt (*W.L.*); Overton, one (Pe.)

D.—Colwyn Bay (N.); Rossett (Do.)

Car.—Capel Curig, o. (A. S. Tetley).

242. **T. munda,** Esp. Widely distributed but local, and found very sparingly where it does occur.

C.—Bromborough, Eastham, and Puddington (*W.L.*): Dunham Park, Marple, and Hooton, n.c. (*E.L.*); Bidston, v.r. (Pr.); Chester (N.); White Hall, near Tarporley 1902 (Stk.); Edge, near Malpas, r. at sallow (F.H.W.D.); Delamere, sp. (Da., A.); ditto, two in 1900 (H.); Hale, on ground under sallows when in bloom, s. (Tp.)

F.—Overton, m.c. (Pe.)

D.—Llangollen (H. B. Jones, *Ent. Rec.* V., p. 224); Colwyn Bay (N.); Ruthin (J. E. R. Allen).

Car.—Deganwy (W.G.)

PANOLIS, Hb.

243. **P. griseovariegata,** Goeze. = **piniperda,** Panz. Common generally wherever there are fir plantations.

C.—Wirral (*W.L.*); Prenton (Sh.); Bidston (Pr.); ditto and Storeton (W.G.); White Hall, near Tarporley (Stk.); Delamere (J., Ta., M., Co., Da.); ditto, at sallow bloom (Thompson, H.); Rudheath, c. (Da., J.); Dunham, n.c. (Ta.); Peover and Wilmslow (Tp.)

F.—Llyn Helig, Cwm Mountain, and Loggerheads (*W.L.*); Cwm Wood (Pe.)

D.—Colwyn Bay (N.)

CALYMNIA, Hb.

244. **C. pyralina,** View. Only one record.

C.—Chester, one at gas lamp (A.)

245. **C. affinis,** L. Of very rare occurrence.

C.—Alderley, v.r. (Mr. Corbett in *E.L.*); Chester, two at e.l. 1899 (Do., N.)

F.—Overton, o. (Pe.)

246. **C. diffinis,** L. Very rare.

C.—Vicar's Cross, near Chester, two at sugar (P.C.)

247. **C. trapezina,** L. Abundant and general.

C.—Common everywhere throughout except, apparently, in the extreme east of the county.

F.—Larvæ c. on oaks (A.); Holywell (*W.L.*); Overton and Cwm, c. (Pe.)

D.—Colwyn Bay (N.)

DYSCHORISTA, Ld.

248. **D. suspecta,** Hb. Local but not uncommon on moss lands and heaths; more common some years than others.

C.—Staley Brushes and between Storeton and Hargreave Hall, s. (*E.L.*); Delamere (H., Da.); ditto, s. (A.); Rudheath and Holford Moss, c. (Da.); Stockport, o. (J.); Macclesfield (R. South).

D.—Colwyn Bay (N.)

249. **D. fissipuncta,** Hw. = **upsilon,** Bkh. Rather local and not often met with, but is probably overlooked.

C.—Wallasey (*W.L.*); ditto, at sugar (Pr.); ditto frequent, West Kirby, Alderley, r., Marple (*E.L.*); Chester, one at e.l. (Do.); ditto, o. (A.); Delamere, one 1899 (H.); Hale (Tp.); Thelwall, l. plentiful under willow bark, July (Co.); Stockport, l. c., but badly infested with ichneumon (J.)

PLASTENIS, B.

250. **P. retusa,** L. Occurs very sparingly.

C.—Knutsford, r., Wallasey, Bidston, Tranmere, and Puddington, n.c. (*E.L.*); Wallasey (M.); Chester, one at e.l., Aug. 1898 (Do.); ditto, one at e.l. (A.); Vicar's Cross, near Chester, one 1901 (P.C.)

251. **P. subtusa,** F. Not quite so rare as the preceding.

C.—Wallasey (*W.L.*, *E.L.*, Pr., J., M.); Bidston, Tranmere, and Puddington, n.c. (*W.L.*); Chester, one at e.l. 1899 (Do.); Vicar's Cross, near Chester, one 1901 (P.C.); Sale and Bowdon, n.c. (*E.L.*); Stockport, two (J.)

D.—Llangollen (*W.L.*)

CHIRRHŒDIA, Gn.

252. **C. xerampelina,** Hb. Not often met with.

C.—Denhall, one (*W.L.*); Chester, one (Da.); ditto, f.c. at e.l. (A., Do.); Vicar's Cross, one (P.C.); White Hall, near Tarporley (Stk.); Ince Marshes, f.c. on ash trunks (N.)

F.—Overton, one from a pupa found (Pe.)

D.—Vale of Clwyd (W.G.)

ANCHOSCELIS (recte ANCHOCELIS), Gn.

253. **A. lunosa,** Hw. Common locally, but by no means general.

C.—Wirral and Lead Works, Chester (*W.L.*); Bidston Lighthouse (*E.L.*); Wallasey (*E.L.*, H., Pr.); Chester, at gas lamps and e.l. plentiful and very variable (A., Do., N.); near ditto, c. at sugar (Da.); Vicar's Cross, f.c. (P.C.); White Hall, near Tarporley (Stk.); Bowdon, at sugar (Tp.)

F.—Overton, one (Pe.)

Car.—Abersoch, c. (Da.)

ORTHOSIA, O.

254. **O. lota,** Cl. Moderately common and widely distributed.

C.—Wallasey, c. (Co., Ta., J., Pr., M.); ditto, l. on willows (Pr.); Oxton and Ledsham (Sh.); Chester, at e.l. (Do., A.); ditto, l. in sallow catkins (A.); Ince Marshes, one (N.); White Hall, near Tarporley (Stk.); Knutsford and Ashton-on-Mersey (Da.); Lower Peover, l., c. 1901 (Da.); Bowdon (Tp.); Stockport (J.)

F.—Rhyl, o. (Pe.)

D.—Vale of Clwyd (W.G.); Colwyn Bay (N.)

Car.—Deganwy (W.G.)

255. **O. macilenta,** Hb. Not uncommon; widely, though not generally, distributed.

C.—Rock Ferry, Eastham, and Puddington (*W.L.*); Eastham, n.c. (Pr.); Ince Marshes, s. (N.); Chester, at gas lamps and e.l., n.c. (A., N., Do.); Delamere, n.u. (Da., Cr., J., M.); White Hall, near Tarporley (Stk.); Bowdon, c. (Da., Tp.)

F.—Holywell (*W.L.*); Overton, o. (Pe.)

D.—Colwyn, c. (*W.L.*, N.)

256. **O. circellaris,** Hufn. = **ferruginea,** Esp. Common and generally distributed.

C.—Wallasey, c. at sugar (Pr., H.); Chester (A.); Delamere, c. (H., Da.); White Hall, near Tarporley (Stk.); Ince Marshes (N.); Stockport (J.)

F.—Overton and Rhyl, c. (Pe.)

D.—Colwyn Bay (N.)

257. **O. helvola,** L. = **rufina,** Hb. Often common where it occurs, but is not generally distributed.

C.—Bromborough, n.c. (Pr.); Eastham, Storeton, and Bidston (*E.L.*); Delamere, a., recorded by all the local collectors; White Hall, near Tarporley (Stk.); Bowdon (Tp.); Alderley district, c., and Staley Brushes, c. (*E.L.*)

F.—Holywell and Loggerheads (*W.L.*); Overton, one (Pe.)

D.—Llangollen and Colwyn (*W.L.*)

258. **O. pistacina,** F. Common and very general.

C.—Common almost everywhere in the county.

F.—Rhyl, one (Pe.)

D.—Vale of Clwyd, a. (W.G.)

Car.—Deganwy and near Conway, a. (W.G.); Abersoch, v.c. (Da.)

259. **O. litura,** L. Common and fairly general.

C.—Wallasey (Pr., M.); Ledsham (Sh.); Chester (A); ditto, at e.l. (Do., A., N.); Delamere, c. (Cr., M., Da., Sh., Ta.); White Hall, near Tarporley (Stk.); Bowdon (Tp.); Dunham (Ta.)

D.—Vale of Clwyd (W.G.)

Car.—Deganwy (W.G.)

XANTHIA, O.

260. **X. citrago,** L. Widely distributed, but rather local and not plentiful as a rule.

C.—Rock Ferry and Puddington (*W.L.*); Bromborough (*E.L.*); Chester (*W.L.*); ditto, at gas lamps and e.l., r. (A.); Knutsford and Tabley, n.u. (Da.); Dunham Park, Bowdon (*E.L.*, Tp.); Wilmslow (*E L.*); Stockport, n.c. (J., M.)

F.—Loggerheads (*W.L.*)

D.—Vale of Clwyd (W.G.)

Car.—Llanfairfechan (Ta.)

261. **X. aurago,** F. Very rare.

C.—"Two taken at Lydiate, end of Sept. (C. S. Gregson" in *E.L.*); Bowdon, one about 1882 (Tp.); Ledsham (Sh.)

F.—Overton, one (Pe.)

262. **X. lutea,** Ström. = **flavago,** F. and **silago,** Hb. Fairly common and general.

C.—Occurs generally throughout the county, though not found plentifully.

F.—Loggerheads (*W.L.*)

Car.—Bangor, taken by E.C.D. (Do.); Abersoch, c. (Da.)

263. **X. fulvago,** L. Common generally.

C.—Common throughout the county. The variety **flavescens,** Esp., is recorded from Chester at e.l. (Do.); Delamere (Ta.); White Hall, near Tarporley (Stk.); and Stockport (J.)

F.—Larvæ plentiful in the county in sallow catkins (A.); Holywell (*W.L.*); Rhyl, o. (Pe.)

D.—Colwyn Bay (N.)

Car.—Deganwy (W.G.); Penmaenmawr (Po.); Abersoch, c. (Da.)

Ang.—Lligwy (Ld. B.)

264. **X. gilvago,** Esp. Found very rarely.

C.—Ness and Puddington, s. (*W.L.*); Eastham, Sept. 1868, Mr. Wm. Lello—*E.M.M.*, V., 129 (*E.L.*); Chester, at e.l., one only (A.); Hale (Tp.); Shavington Park (Th.)

F.—Overton, m.c. (Pe.)

HOPORINA, Blanch.

265. **H. croceago,** F. Recorded from two localities only, both in Carnarvonshire.

Car.—Bettws-y-Coed (F. Birch); Capel Curig (A. S. Tetley).

ORRHODIA, Hb.

266. **O. vaccinii,** L. Common almost everywhere.

267. **O. ligula,** Esp. = **spadicea,** Haw. Widely distributed but not plentiful.

C.—Wirral (*W.L.*); Wallasey (*E.L.*); Eastham (Pr.); ditto, at sugar in March (Sh.); Chester (*W.L.*); ditto, o. at e.l. (Do.); Delamere, u. (Da., M.); White Hall, near Tarporley (Stk.); Dunham Park, Bowdon (*E.L.*, Tp.)

F.—Holywell and Loggerheads (*W.L.*); Overton and Rhyl, c. (Pe.)

D.—Llangollen (B.); Vale of Clwyd (W.G.)

Car.—Deganwy (W.G.)

SCOPELOSOMA, Curt.

268. **S. satellitia,** L. Common generally.

C.—Eastham (Sh.); Prenton (Pr.); Chester, at gas lamps and e.l., o. (A.); ditto, one (Do.); Ince Marshes, s. (N.); White Hall, near Tarporley (Stk.); Delamere, c. (Da., Ta., M., J., H.); Bowdon (Tp.); Stockport, c. (J.)

F.—Overton and Cwm, c. (Pe.)

D.—Colwyn Bay (N.)

Car.—Abersoch, c. (Da.)

XYLINA, Tr.

269. **X. socia,** Rott. = **petrificata,** Tr. Only one record.

Car.—Capel Curig (A. S. Tetley).

270. **X. ornitopus** (*recte* **ornithopus**), Rott. = **rhizolitha,** Tr. Of rare occurrence, especially in Cheshire.

C.—Upton and Denhall, s. (*W.L.*); Chester, at gas lamp in Wrexham Road, s. (A.)

D.—Colwyn (*W.L.*, N.); Llangollen Valley (T. S. Ashworth in *Zoologist*, Vol. XIII., 1855).

Car.—Bettws-y-Coed (B.); ditto, c. (A. Druitt); near Conway (W.G.)

CALOCAMPA, Stph.

271. **C. vetusta,** Hb. Appears to be widely distributed, though of sparing occurrence.

C.—Wallasey, Bidston, and Upton, s. (*W.L.*); Eastham, local (*E.L.*, W.G.); near Chester, s. (A.); Delamere (Mrs. Leather in *W.L.*); Ashton-on-Mersey (Stb.)

F.—Holywell (*W.L.*)

D.—Llangollen (B.)

Car.—Deganwy (W.G.); Bettws-y-Coed (B.); Llanfairfechan, l. (Ta.); Capel Curig (A. S. Tetley); Abersoch, u. (Da.)

272. **C. exoleta,** L. Somewhat local but widely distributed; more common than the preceding species.

C.—Wirral, n.a. (*W.L.*); Wallasey, n.u. (Pr., M., *E.L.*); Eastham Wood (W.G.); ditto and Liscard, c. (*E.L.*); near Chester, one (A.); ditto, m.c. (Da.); ditto and Ince (*W.L.*); Delamere, m.c. (Da., H., J.); Bowdon (Tp.)

F.—Loggerheads (*W.L.*); Rhyl, one (Pe.)

D.—Llangollen 1894 (H. B. Jones—*Ent. Rec.*, Vol. V., p. 224); ditto and Colwyn (*W.L.*)

Car.—Deganwy (W.G.); the coast 1900 (J.); Abersoch, m.c. (Da.)

273. **C. solidaginis,** Hb. Recorded from three localities only, but is generally common where it occurs.

C.—Staley Brushes, c. (*E.L.*); Delamere, c., recorded by all the local collectors; Whaley Bridge, f.c. (Cr., J., Da.)

XYLOCAMPA, Gn.

274. **X. areola,** Esp. = **lithorhiza,** Tr. Widely distributed, but by no means general or common.

C.—Wirral and (?) Helsby (*W.L.*); Prenton (Pr.); Ince Marshes, s. (N.); Chester, two at e.l. 1899 (Do.); near ditto, o. (A.); Delamere, one on a tree trunk 1895 (H.)

F.—Overton, o. (Pe.)

D.—Colwyn Bay (N.)

Car.—Near Conway (W.G.); Conway Valley (Bl.)

Ang.—Lligwy (Ld. B.)

CUCULLIA, Schrk.

275. **C. verbasci,** L. Of very rare occurrence.

C.—One l. in a garden at Mere, near Knutsford 1902—probably introduced accidentally (Da.)

D.—Larvæ swarmed on the roadside mulleins at Glyn Ceiriog, near Chirk Castle, in 1858-1859 (Pe.)

276. **C. umbratica,** L. Widely and generally distributed; often common.

C.—Bidston and Ness (*W.L.*); Wallasey (*W.L.*); ditto, l. (Pr., J., M.); Bebington (Sh.); Chester, p. (*W.L.*, N., Do., A.); Ince Marshes, f.c. (N.); Vicar's Cross, two (P.C.); White Hall, near Tarporley, f.c. (Stk.); Delamere, c. at flowers of pinks 1899 (H.); Knutsford, o. (Da.); Bowdon (Tp.); Carrington (Stb.); Stockport, f.c. (J.)

F.—Holywell and Rhyl (*W.L.*); ditto, c., and Overton, o. (Pe.)

D.—Colwyn Bay (N.)

Car.—Llandudno (*W.L.*); Deganwy (W.G.); Bettws-y-Coed (Bl.); Abersoch, c. (Da.); on coast 1900 (J.)

Ang.—Near Holyhead, in swarms 1900 (R. Freer, *E.M.M.*, Vol. XII., p. 13.)

277. **C. chamomillæ,** Schiff. Recorded only from Cheshire, where it appears to be generally distributed though not common.

C.—Bidston and Denhall, s. (*W.L.*); Wallasey, l., n.u. (Pr., J.); Tranmere (W.G.); near Birkenhead, l. (M.); Ince Marshes, s. (N.); Chester, four or five at e.l. 1899 and 1900 (Do.); White Hall, near Tarporley, a few at e.l. (Stk.); Knutsford, one 1900 (Da.); Warburton (Tp.); Bowdon, r. (*E.L.*)

ANARTA, Hb.

278. **A. myrtilli,** L. Common on most heaths and mosses.

C.—Wirral (*W.L.*); a. in the Delamere district, including Abbot's Moss, Whitegate Heath, and Clarke's Moss. White Hall, near Tarporley (Stk.); Alderley and Wilmslow (Tp.); Holford Moss (Da.); Stretton Moss (Co.); Oxton Moor (Pr.); Heswall and Bidston Hill (W.G.)

F.—Loggerheads (*W.L.*)

D.—Coed Coch (N.); Llangollen (B.)

Car.—Penmaenmawr, on mountains (Po.); mountains (W.G.); the coast 1900 (J.); Abersoch (Da.)

HELIACA, H.S.

279. **H. tenebrata,** Sc. = **arbuti,** F. Local and rather scarce.

C.—Prenton Lane, Puddington, and Beeston Castle (*W.L.*); between Spital and Parkgate, also Wilmslow, Knutsford, Ashley, and Mobberley (*E.L.*); Bidston, r. (Pr.); Heswall Hill, one (W.G.); Chester, Sealand Road and district, p. (A., Mr. Thompson); ditto, Lead Works garden (N.); Upton, near Chester, s. (N.); Delamere, (M., A., N.)

F.—Bagillt and Loggerheads (*W.L.*)

HELIOTHIS, O.

280. **H. peltigera,** Schiff. Of rare occurrence.

C.—Wallasey, one in 1879 on ragwort flowers (W.G.); ditto, "Mr. Wilding found one and the wings of a second on the sandhills, 17th July, 1884" (*E.L.*); ditto, one (Co.); ditto, one "by raking" 1887 (Pr.)

Car.—Abersoch, two in 1894 (Da.)

281. **H. armigera,** Hb. Of rare occurrence.

C.—One in 1857 on salt marsh near the mouth of Bromborough Pool (Mr. G. A. Almond in *W.L.*); also recorded from Stalybridge by Mr. J. B. Hodgkinson in *E.L.*; Chester, one at e.l., Sept. 9th, 1901 (A.)

F.—Brymbo and Nant-y-ffrith, at light (N.)

PYRRHIA, Hb. = CHARICLEA, St.

282. **P. umbra,** Hufn. = **marginata,** F. Local but not uncommon where it occurs. Found generally on the coast where the food plant, Rest-harrow, grows.

C.—New Ferry, generally s. (*W.L.*); Wallasey, f.c. (Pr., H., J., Ta.); ditto, l., c. (M.); Chester (A. O. Walker); ditto, one at e.l. (A.)

F.—Rhyl (*W.L.*); ditto, o. (Pe.); Brymbo, s. (N.)

Car.—Abersoch, c. (Da.); the coast 1900 (J.)

Ang.—Near Holyhead (R. Freer in *E.M.M.*, Vol. XII., p. 13 N.P.)

ERASTRIA, O.

283. **E. uncula,** Cl. Recorded only from Abersoch (Carnarvonshire)—a few in 1900 (J.); ditto, one 1900 (Da.)

284. **E. fasciana,** L. Only one record. Chester, one specimen at e.l., end of June 1901, by Mr. E. C. Dobie.

RIVULA, Gn.

285. **R. sericealis,** Sc. The only records to hand are:

C.—Not abundant, Ledsham (*W.L.*); s. and local, Wallasey (*E.L.*); Sealand Pond, near Chester, c. (A.); North Cheshire (N.G.)

PROTHYMNIA, Hb.

286. **P. viridaria,** Cl. = **œnea,** Hb. Fairly common where it occurs, but local and by no means general.

C.—Bidston Hill (*W.L.*); Prenton, Delamere Forest, Lindow Common, c. (*E.L.*); North Cheshire (N.G.)

D.—Colwyn (*W.L.*); ditto and Abergele (N.)

C.—Llandudno (N.); coast 1900 (J.)

GONOPTERINÆ.

SCOLIOPTERYX, Germ. = GONOPTERA, Lat.

287. **S. libatrix,** L. Not in great numbers, but widely and generally distributed.

C.—Found more or less commonly in most parts of the county.

F.—No records.

D.—Colwyn Bay (N.)

Car.—Deganwy (W.G.); Bettws-y-Coed (Bl.); Llanfairfechan (Ta.); Abersoch, m.c. (Da.)

Ang.—Lligwy (Ld. B.)

QUADRIFINÆ.

ABROSTOLA, O.

288. **A. triplasia,** L. Not plentiful, but widely and fairly generally distributed.

C.—Wallasey, Ness, and Puddington, s. (*W.L.*); Oxton (*W.L.*, Sh.); Tranmere (*W.L.*); ditto, l. on hop (Pr.); Ince Marshes, a. (N.); Chester (*W.L.*); ditto, v.c. at e.l. (A., Do.); Vicar's Cross (P.C.); White Hall, near Tarporley (Stk.); Delamere (Da.); ditto, two in 1899 (H.); Knutsford, n.u. 1900 (Da.); Alderley (*E.L.*); Stockport, a few at campion flowers 1900 (J.); Hale (Tp.); Carrington (Stb.); Latchford and Thelwall (Co.)

F.—Holywell (*W.L.*); Overton and Rhyl, c. (Pe.)

D.—Colwyn, at *Centranthus* flowers (*W.L.*); Colwyn Bay (N.)

Car.—Deganwy (W.G.)

289. **A. tripartita,** Huf. = **urticæ,** Hb. Much rarer than the preceding species.

C.—Wallasey (*E.L.*); Ince Marshes, s. (N.); Chester, three at e.l. 1900 (Do.); Vicar's Cross, one (P.C.); White Hall, near Tarporley, a few taken (Stk.); Knutsford, one 1901 (Da.); Alderley (*E.L.*); Carrington (Stb.)

F.—Holywell, at flowers of *Centranthus ruber* (*W.L.*)

D.—Colwyn Bay (N.)

PLUSIA, O.

290. **P. chrysitis,** L. Widely and generally distributed, but not common everywhere.

C.—Wallasey, l. and imago, f.c. (Pr.); West Kirby and Oxton (Sh.); ditto, Tranmere and Hoylake (W.G.); Ince Marshes, c. (N.); Chester and district, v.c. (A., N.); ditto, a. at e.l. (Do.); Vicar's Cross, c. (P.C.); White Hall, near Tarporley (Stk.); Delamere, c., flying over nettles (H.); Knutsford, o. (Da.); Dunham (Tp.); Walton (Co.); Carrington (Stb.); Marple and Wilmslow, n.c., also Alderley (*E.L.*); Stockport, a few at campion flowers (J.)

F.—Overton and Rhyl, o. (Pe.); Nant-y-ffrith district (N.)

D.—Colwyn Bay (N.)

Car.—Deganwy (W.G.); Abersoch, o. (Da.)

Ang.—Lligwy (Ld. B.)

291. **P. bractea,** F. A few records for Cheshire only.

C.—Bowdon, Marple, Disley, and Macclesfield, r. (*E.L.*); Macclesfield (R. South); Sale, one taken by Mr. Brakespear (Da.); Werneth Low, Aug. 1839 (R. S. Edleston in *Zoologist*, Series 1, Vol. III., p. 1007).

292. **P. festucæ,** L. Local but not uncommon.

C.—Round Birkenhead, Puddington (*W.L.*); Leasowe, s. of late years (Pr.); Ince Marshes (N.); near Chester, from iris and reeds (A., N.); ditto, two broods at e.l. (Do., A.); Vicar's Cross, f.c. (P.C.); Edge, near Malpas (F.H.W.D.); White Hall, near Tarporley (Stk.); Hatchmere, one (H.); near Abbot's Moss, pupæ in cocoons on bog-bean (Co.); Knutsford, a few (Da.); Bowdon (Tp.); ditto, Alderley, and Cheadle Hulme, r., also Heatley, c. (*E.L.*); Carrington (Stb.); Stockport, one (J.)

F.—Near Rhyl (W.G.)

Car.—Abersoch, c. (Da.)

293. **P. pulchrina,** Hw. = **v-aureum,** Gn. Occurs only sparingly as a rule.

C.—Puddington, seems s., Rock Ferry (*W.L.*); West Kirby and Frankby, at briar flowers (*E.L.*); Leasowe, n.c. (Pr.); Ince Marshes, sp. (N.); Chester (*W.L.*); ditto, c. at e.l. (Do., A.); ditto, at flowers (A.); Vicar's Cross, one (P.C.); White Hall, near Tarporley (Stk.); Bowdon (*E.L.*); Carrington (Stb.); Stockport, a few (J.)

F.—Loggerheads and Holywell (*W.L.*); Overton and Rhyl, o. (Pe.)

D.—Colwyn Bay (N.)

294. **P. iota,** L. Somewhat more common than the preceding species.

C.—Puddington (*W.L.*); Leasowe, n.c. (Pr.); New Brighton and Bromborough (*E.L.*); near Hooton (Sh.); Ince Marshes, f.c. (N.); Chester, c. at e.l. (Do., A., N.); Vicar's Cross (P.C.); White Hall, near Tarporley, f.c. (Stk.); Delamere, c. in 1898 (H.); Mid-Cheshire, n.c. (Da.); Alderley and Bowdon (*E.L.*); Carrington, f.c. (Stb.); Stockport (J.)

F.—Holywell, c. (*W.L.*); Overton and Rhyl, m.c. (Pe.)

D.—Colwyn Bay (N.)

Car.—Deganwy (W.G.)

295. **P. gamma,** L. Common everywhere throughout.

296. **P. interrogationis,** L. Recorded from two localities only.

C.—Staley Brushes, four, by T. Hague (*E.L.*); also from the same locality by Mr. Edleston, Aug. 24th, 1844 (*Zoologist*, Vol. II., p. 734).

D.—Llangollen—from *Stainton's Manual* (*W.L.*)

EUCLIDIA, O.

297. **E. mi,** Cl. Very seldom met with in Cheshire, and apparently not common in any of the Welsh counties.

C.—Wallasey sandhills, s. (*W.L.*); railway bank between Wallasey and Spital, c. (*E.L.*, Pr.); near Bromborough (W.G.); White Hall, near Tarporley, two (Stk.); Ashley, formerly (*E. L.*); Shavington Park (Th.)

F.—Wood near Llyn Helig, Bagillt, and Loggerheads (*W.L.*)

D.—Colwyn (*W.L.*, N.); Abergele (N.); Ruthin (W.G.)

Car.—Gloddaeth and Llandudno (N.); coast 1900 (J.)

298. **E. glyphica,** L. Found in but few localities, and generally very sparingly.

C.—Eastham, Shotwick, Chester, and Beeston (*W.L.*); on railway bank at Spital, n.u. (Pr., W.G., *E.L.*); Ashley, formerly c., and Knutsford 1857 (*E.L.*); not recorded from either of the last two localities for many years (Da.); White Hall, near Tarporley, one (Stk.); Kinnerton 1901 (Do.)

F.—Loggerheads and Bagillt (*W.L.*)

D.—Colwyn (*W.L.*, N.); Abergele (N.); Ruthin (W.G.)

Car.—Gloddaeth and Llandudno (N.); coast 1900 (J.)

PSEUDOPHIA, Gn. = OPHIODES, Gn.

299. **P. lunaris,** Schiff. One taken at sugar, June 1901, Delamere Forest, Cheshire, by Mr. T. Wright, of Warrington (*Ent.* XXXV., p. 25).

CATOCALA, Schrk.

300. **C. fraxini,** L. The only records to hand (none recent) are:

C.—Eastham and Upton Road, Birkenhead (*W.L.*); Saughall Massie (one in Mrs. Peacock's garden), Bowdon (recorded by Jos. Chappell); one near Carrington Moss—R. S. Edleston in *Zoologist* (1846) p. 1515 (*E.L.*)

HYPENINÆ.

ZANCLOGNATHA, Ld.

301. **Z. tarsipennalis,** Tr. Rather scarce.

C.—Burton and Puddington, s. (*W.L.*); Wallasey (*E.L.*); Ince Marshes, s. (N.); Chester (N., A.); ditto, at e.l. (Do.); White Hall, near Tarporley (Stk.); Delamere (H.); ditto and Knutsford (Da.)

F.—Holywell (*W.L.*)

D.—Colwyn Bay (N.)

302. **Z. grisealis,** Hb. = **nemoralis,** F. Common and generally distributed.

C.—Eastham and other woods in Wirral (*W.L.*); Bidston, n.u., Bromborough Wood, o. (*E.L.*); Ince Marshes, s. (N.); Chester (N.); ditto, at e.l. (Do.); Sealand Pond, near ditto (A.); Delamere (Th.); Holford Moss, c. (Da.); Bowdon (Tp.); Alderley district, a. (*E.L.*)

F.—Holywell (*W.L.*)

D.—Colwyn Bay (N.)

MADOPA, Stph.

303. **M. salicalis,** Schiff.

C.—Dunham (Tp.)

HERMINIA, Latr.

304. **H. derivalis,** Hb.

C.—Near Chester, also at e.l., Chester (A.)

BOMOLOCHA, Hb.

305. **B. fontis,** Thnb.

C.—Chester, one at e.l., 16th July 1900 (Do.)

HYPENA, Schr.

306. **H. proboscidalis,** L. Common almost everywhere.

C.—Common throughout the county.

F.—Overton, Rhyl, Cwm, o. (Pe.)

D.—Colwyn Bay (N.)

Car.—Abersoch (A.)

HYPENODES, Gn.

307. **H. tænialis,** Hb. = **albistrigatis,** Hw.

C.—Wallasey, one only, by J. Cosmo Melvill, F.L.S. (*E.L.*)

308. **H. costæstrigalis,** Stph.

C.—Bidston Hill Fir Wood, and Prenton Mt. Wood (*W.L.*); Leasowe, n.u. (Pr,)

THOLOMIGES. Ld.

309. **T. turfosalis,** Wck. Local, but abundant where it occurs.

C.—Delamere (*Stainton's Manual*); North Cheshire (N.G.); Wybunbury Moss, a. (F. C. Woodforde and *E.L.*)

CYMATOPHORIDÆ.

HABROSYNE, Hb. = GONOPHORA, Br.

310. **H. derasa,** L. Only occasionally met with, and by no means generally distributed.

C.—Bidston (Sh.); ditto, at sugar, o. (Pr.); West Kirby (F. N. Pierce in *E.L.*); Storeton (W.G.); Chester, n.u., at e.l. (Do.); ditto, n.c., also at sugar (A.); ditto, s., one at Hough Green by Mr. Bolland (N.); Heron Bridge, near Chester (Da.); White Hall, near Tarporley, o. (Stk.); Delamere, f.c. at sugar (H.);

near Cuddington, at sugar (Co.); Lymm (J. C. Melvill in *E.L.*); Dunham, rather s. (Tp.)

D.—Segrwyd, near Nant Glyn (B.)

Car.—Near Deganwy (W.G.); Penmaenmawr, n.c. (Ta.); Abersoch, at sugar (Da.)

THYATIRA, Hb.

311. **T. batis,** L. Rather more common and more generally distributed than the preceding species.

C.—Eastham and Puddington (*W.L.*); Storeton (W.G.); Bebington (Sh.): Ince Marshes, v.r. (N.); Chester (Da., N.); ditto, at e.l., r., also at sugar (A.); Edge, near Malpas, at sugar and light, r. (F.H.W.D.); White Hall, near Tarporley, o. (Stk.); Delamere, f.c. (H.); near Cuddington, f.c. at sugar (Da., Co.); Holford Moss, f.c. (Da.); Ashley, Hale, and Bowdon, at sugar (Tp.)

F.—Near Holywell (*W.L.*)

D.—Colwyn 1884 (*W.L.*); ditto, s. (N.); Llandulas (Sh.); ditto, about 1880 (E. C. Dobie).

Car.—Near Deganwy (W.G.); Bettws-y-Coed (Bl.); Abersoch, at sugar (A.)

CYMATOPHORA, Tr.

312. **C. duplaris,** L. Fairly plentiful on moss lands in Cheshire where birches grow. In such situations the prevailing form is **ab. obscura,** Tutt., being entirely of a sooty black. There are no records for Carnarvonshire and Anglesea.

C.—Prenton Wood, s. (*W.L.*); White Hall, near Tarporley, o. (Stk.); Delamere, o. (J.); ditto, n.u. (Da.); ditto, in 1900 (Tp.); ditto, among birches (Co.); ditto, l., v.c. (A., N.); Holford Moss (Da.); Dunham, near Bowdon (Tp.); ditto, c. in 1899 (Ta.)

F.—Overton, one (Pe.)

D.—Gresford (Archer in *W.L.*)

POLYPLOCA, Hb. = ASPHALIA, Ld.

313. **P. diluta,** F. Of rare occurrence; the only records are:

C.—Eastham, o. (C. S. Gregson in *E.L.*); Chester, one at e.l. 1901 (A.); Delamere, one at sugar in 1893 (Da.)

314. **P. flavicornis,** L. Not uncommon, though not found in any great numbers.

C.—Bidston Park Wood, s. (N.G. in *W.L.*); Eastham Wood (*E.L.*); Wallasey, now v.s. (Pr.); Chester, two at e.l. 1900 (Do.); Delamere, recorded by all the local collectors; White Hall, near Tarporley (Stk.); Pettypool (Co.); Rudheath (J., Da.); Knutsford (Da.); Wilmslow (Tp.); Macclesfield, l., v.c. (R. South).

F.—Overton (Pe.)

Car.—Capel Curig (A. S. Tetley).

BREPHIDÆ.

BREPHOS, O.

315. **B. parthenias,** L. Very local, though common where it occurs.

C.—Delamere, c. most years, a. in 1902. Taken or seen by most who have collected in the Forest about Eastertide. White Hall, near Tarporley (Stk.); Pettypool Wood, on fine March days (Co.); Rudheath (J.); Shavington Park, one in 1898 (Th.)

D.—Between Minera and Llangollen (Da.)

GEOMETRIDÆ.

GEOMETRINÆ.

PSEUDOTERPNA, Hb.

316. **P. pruinata,** Hufn. = **cytisaria,** Schiff. Occurs throughout the district, but local.

C.—Claughton Fir Wood, Haddon Wood, and Ness (*W.L.*); Bidston Hill (*W.L.*); ditto, c., and Oxton Moor, l. on furze (Pr.); West Kirby, Barnston, and Little Sutton (Sh.); Ince Marshes, s. (N.); Chester (N.); ditto, one at e.l. 1899 (Do.); ditto, one at gas lamp (A.); White Hall, near Tarporley (Stk.); near ditto, one in 1902 (Da.); Delamere, c. (A., M., N.); Tatton Park (*E.L.*)

F.—Loggerheads (*W.L.*)

D.—The Leet, c. (A.); Ruthin (W.G.); Colwyn Bay (N.); near Bryndyddrin (B.)

Car.—Deganwy and Conway (W.G.); near Penmaenmawr (Po.); Abersoch, c. (Da.)

Ang.—Near Holyhead (R. Freer, *E.M.M*, Vol. XII., p. 13).

GEOMETRA, L.

317. **G. papilionaria,** L. Generally distributed, though local and nowhere very plentiful.

C.—Bidston, Rock Ferry, and Ledsham, s. (*W.L.*); once taken at Bidston by the late A. G. Almond (Pr.); Eastham Wood, o. (*E.L.*); Ince Marshes, v.r. (N.); Chester, n.u. at e.l. (Do., A.); ditto, r. at light (N.);

Huntington Wood, near Chester (Da.); Edge, near Malpas, light and beating, r. (F.H.W.D.); Delamere (M., Tp., A., Da., J., Cr., H.); ditto, l. (Th., N., Ta.); Pettypool Wood (Co.); White Hall, near Tarporley, a few (Stk.); Rudheath, s. (Da.); Knutsford, r., Dunham Park, r., Cheadle Hulme, and Alderley (*E.L.*); Alderley Edge (C. Oldham); Lindow Common (Tp.); Cock's Moss, near Macclesfield (R. South).

F.—Holywell (*W.L.*)

D.—Gresford and Bathafarn (*W.L.*); Colwyn Bay, apparently s. (N., O. Whittaker).

Car.—Near Conway (W.G.)

EUCHLORIS, Hb. = PHORODESMA, B.

318. **E. pustulata,** Hufn. = **bajularia,** Schiff. Very scarce; the only records are:

C.—Chester, at e.l., s. (J. Byron Denson); ditto, two at e.l.—one in 1899 and one in 1900 (Do.); Delamere, s. (N.); White Hall, near Tarporley, a few at e.l. 1900 (Stk.)

THALERA, Hb.

319. **T. lactearia,** L. Common and generally distributed.

HEMITHEA, Dup.

320. **H. strigata,** Müll. = **thymiaria,** Gn. Not met with generally, though apparently moderately common in some places.

C.—Wirral, n.a. (*W.L.*); Bidston, Parkgate, and Wallasey (*E.L.*); Parkgate (W.G.); Moreton, never c. (Pr.); Elton Green, near Ince (Co.); Chester, n.u. at e.l. (Do.); Sealand, near Chester, c. (A.); Vicar's Cross, c. (P.C.); White Hall, near Tarporley (Stk.); Pettypool Wood (Co.)

F.—Holywell (*W.L.*); Overton and Rhyl, c. (Pe.)

D.—Colwyn Bay (N.)

Car.—Abersoch (Da.)

ACIDALIINÆ.

ACIDALIA, Tr.

321. **A. muricata,** Hufn. = **auroraria,** Bkh. No recent records for the district. It is still found sparingly on one of the Lancashire mosses, just beyond the boundary of Cheshire. The local form is deep rose colour with very little yellow.

C.—North-east Cheshire, on the authority of N. Greening (*W.L.*); Lindow Common and Carrington Moss (*E.L.*) It has probably been exterminated in the latter locality since the moss has been reclaimed by the Manchester Corporation, and put under cultivation (Da.)

322. **A. dimidiata,** Hufn. Recorded as common throughout, including Anglesea.

323. **A. contiguaria,** Hb. Recorded only from Carnarvonshire, where it appears to be widely distributed, though not very plentiful.

Car.—Penmaenmawr district (Po., Ta., F.H.W.D., J., W.G., Da.); Conway (Tp.); Conway mountain and near Criccieth (W.G.); ditto (E. B. Nevison); near Abersoch (Da.)

324. **A. virgularia,** Hb. = **incanaria,** Hb. Appears to be common locally in a few places, but is by no means generally distributed.

C.—Not scarce on Bidston Hill, and occasionally elsewhere; Tranmere and Lead Works, Chester (*W.L.*); Chester, at e.l., and c. everywhere (A.)

Car.—Penmaenmawr, c. (Po., A.); Llanfairfechan (A.); Abersoch, one 1896 (Da.)

Ang.—Beaumaris Castle (A.)

325. **A. subsericeata,** Hw. Local and not often met with.

C.—Bidston, s. (*W.L.*); pasture lands near Leasowe sandhills, also Wallasey (*E.L.*); ditto, n.u. (Pr.), o. (J., W.G.); Cock's Moss, near Macclesfield (R. South, *Ent.* XXVIII., p. 270).

F.—Overton, one 1865-75 (Pe.)

Car.—On south coast 1900 (J.)

326. **A. straminata,** Tr. Only one record.

C.—Whitegate Heath 1901 (Da.)

326a. " **var. circellata,** Gn.

C.—"Bowdon: specimens collected here are in the collection of Mr. J. Cosmo Melvill" (*E.L.*)

327. **A. bisetata,** Hufn. Common and generally distributed throughout.

328. **A. trigeminata,** Hw.

C.—Recorded in *E.L.*, on the authority of Jos. Chappell as from Barlow Moor, but not occurring there commonly.

329. **A. dilutaria,** Hb. = **holosericata,** Dup.

C.—*E.L.* states: "The only recorded locality for this species is below Bidston Plantation looking toward Moreton, in plantations where the ground is swampy" (C. S. Gregson).

330. **A. interjectaria,** Bdv. = **dilutaria,** Hein, and **osseata,** F. Very local and rarely met with.

C.—"Not uncommon on the margin of the sandhills near Wallasey village; c. at Ness and Burton" (J. F. Brockholes in *W.L.*); hedges near Leasowe sandhills (*E.L.*); Barlow Moor, c. (*E.L.*)

331. **A. inornata,** Hw. Rare.

C.—Staley Brushes, r. (Jos. Chappell and J. B. Hodgkinson in *E.L.*); Delamere (B. H. Crabtree).

332. **A. aversata,** L. The **ab. spoliata,** Stgr. is the commonest form, and is generally distributed. The type, **aversata,** with the dark fascia, is sometimes found on the mosses.

333. **A. emarginata,** L. Very rare and local.

C.—Bidston (W. Johnson in *E.L.*); Barlow Moor (Jos. Chappell in *E.L.*)

F.—Rhyl (W.G.)

334. **A. marginepunctata,** Göze = **promutata,** Gn. Recorded from Carnarvonshire and Anglesea only; not plentiful.

Car.—Conway (Ta.); on the lower rocks between Conway and Penmaenmawr (Po., Da.); Llandudno (Po.); Abersoch, c. (Da.)

Ang.—Near Holyhead (R. Freer, *E.M.M.*, Vol. XII., p. 13).

335. **A. fumata,** Stph. *E.L.* states: "plentiful on all the moss lands," but we have not found it so in Cheshire. The only records available are:

C.—East of the county, by N. Greening (*W.L.*); Goyt's Clough and Holford Moss, r. (Da.); near Whaley Bridge (J.)

336. **A. remutaria,** Hb. Common and generally distributed; "most frequent in woods" (*W.L.*)

337. **A. immutata,** L. The only record is:

C.—Wybunbury Moss, n.c. (F. C. Woodforde).

338. **A. imitaria,** Hb. Generally distributed, but not numerous as a rule.

C.—Bidston and Ness (*W.L.*); West Kirby (Sh.); Prenton, never c. (Pr.); Chester, c. (*W.L.*); ditto, n.u. at e.l. (Do.); Delamere, one (A.); ditto, several in 1900 (H.); near Tarporley (Stk., Da.)

F.—Holywell (*W.L.*); Rhyl (W.G.); ditto and Overton, m.c. (Pe.)

D.—Ruthin (W.G.)

Car.—Abersoch (Da.)

EPHYRA, Dup. = ZONOSOMA, Ld.

339. **E. porata,** F.

C.—Recorded from Delamere Forest, r., on the authority of Joseph Chappell in *E.L.*

340. **E. punctaria,** L. Recorded from Cheshire only.

C.—Eastham Wood, s. (*W.L.*); Bidston and Dunham Park (*E.L.*); Delamere, f.c. (H., Da., Th., Ta., Tp., M.)

341. **E. linearia,** Hb. = **trilinearia,** Bkh.

C.—Recorded in *E.L.* from Dunham Park and Tatton Park on the authority of the late Mr. Jos. Chappell, but it has not been found in recent years, and it is doubtful if the species occurs in these localities now.

F.—Wood near Holywell (*W.L.*)

TIMANDRA, Dup.

342. **T. amata,** L. = **amataria,** L. This is a rather uncommon species in the district, though taken fairly freely near Chester.

C.—Ness, Puddington, Chester, and Ince, n.c. (*W.L.*); Prenton, never c. (Pr.); lane leading from Liscard to Wallasey Church (J. W. Ellis); Backford (W.G.); Chester (N.); ditto, at e.l., c. (Do.); ditto, s., also at Sealand, near Chester, a., and Lache Lane, Chester (A.); Vicar's Cross, near Chester, f.c. (P.C.); Delamere, several in 1900 (H.); White Hall, near Tarporley, a few (Stk.); Edge, near Malpas, n.c. (F.H.W.D.)

F.—Overton, m.c. (Pe.)

D.—Colwyn Bay (N.)

LARENTIINÆ.

STERRHA, H. S.

343. **S. sacraria,** L. Probably extinct now. No recent records.

C.—Ness, s. (*W.L.*); one on Aug. 16th, at Wallasey, and one on Aug. 21st, 1867, at Poulton, captured on ragwort flowers; another specimen at the latter locality being lost (E. L. Ragonot in *E.M.M.*, Vol. IV., p. 131); one at Wallasey (C. S. Gregson in *E.M.M.*, Vol. V., p. 129; *E.L.*) Mr. H. B. Prince writes as follows: "I never took the species, but there is abundant proof of many being taken. Domiciled in Birkenhead, the Frenchman, Ragonot, I know took it; also the late Mr. Gregson and Mr. Almond; and I think Mr. T. Roxburgh got a specimen or two also when Wallasey was not a Golf Links."

ORTHOLITHA, Hb.

344. **O. plumbaria,** F. Widely distributed and common where it occurs.

C.—Occurs in only a few localities: Bidston (Sh., Pr.); White Hall, near Tarporley (Stk.); Delamere, f.c. (A., H., M.); Oakmere (N.)

F.—The Leet (A.); Rhyl, s. (Pe.)

D.—Colwyn Bay and Llandulas (N.)

Car.—Gloddaeth, Llandudno, c. (N.); Penmaenmawr, a. (Po., Da.); Abersoch, c. (A., J., Da.)

Ang.—Near Holyhead, very fine and dark (R. Freer, *E.M.M.*, Vol. XII., p. 13).

345. **O. cervinata,** Schiff. Though widely distributed and fairly plentiful where it does occur, the localities recorded are few.

C.—Tranmere, formerly n.u. in Clifton Park, Birkenhead (*W.L.*); West Kirby, n.c. (Pr.); Bidston and Hoylake (*E.L.*); Sealand, near Chester (A.); Helsby (N.); White Hall, near Tarporley (Stk.)

F.—Rhyl, c. (Pe.)

Car.—Abersoch, c. (Da.)

Ang.—Lligwy (Ld. B.)

346. **O. limitata,** Sc. = **mensuraria,** Schiff. Common generally and widely distributed, though it appears to be far from plentiful in the Mid-Cheshire district (Da.)

347. **O. bipunctaria,** Schiff. In *Ellis's List* it is stated—"Mr. Gregson records the occurrence of this species at Hoylake at the mouth of the Dee in July 1845." We consider this an unlikely locality to find the insect, and it has certainly not been taken there in recent years.

MESOTYPE, H. S.

348. **M. virgata,** Rott. = **lineolata,** Hb. Recorded from three localities only—all on the coast.

C.—North Wirral sandhills, c., recorded by all who have collected there.

F.—Rhyl sandhills, c. (Pe., W.G.)

Car.—Deganwy (W.G.)

ODEZIA, B.

349. **O. atrata,** L. = **chærophyllata,** L. Local, though generally plentiful where it occurs.

C.—Oxton, Bidston, &c., n.u. (Pr.); Dee Banks, near Farndon (N.); Knutsford, r. (Da.); ditto and Bramall (*E.L.*); Stockport, o. (J.); Langley Pool, Macclesfield, v.c. (R. South); near ditto, c. (J.); borders of Cheshire between Macclesfield and Buxton, c. (Da.)

F.—Bagillt (*W.L.*)

D.—Ruthin (W.G.)

Car.—Deganwy and Bettws-y-Coed (W.G.); Abersoch (A., Da.)

Ang.—Bull Bay, c. (N.)

ANAITIS, Dup.

350. **A. plagiata,** L. Rare in Cheshire; not uncommon in N. Wales.

C.—Chester, two at e.l. 1899 and 1900 (Do.); ditto, one, also two at Capenhurst (A.); White Hall, near Tarporley (Stk.); Hale, r. (Tp.); recorded from Marple, Bowdon, Knutsford, and Delamere, n.c., on the authority of Jos. Chappell in *E.L.*; but the species has not been noticed in the three last-named localities for some years past.

F.—Overton, one (Pe.); The Leet, c. (A.); Loggerheads and Holywell (*W.L.*)

D.—Ruthin (W.G.); Abergele and Colwyn Bay (N.); Llandulas (Sh.)

Car.—Llandudno (N.); Deganwy and Conway (W.G.); south coast 1900 (J.); Abersoch, c. (Da.)

Ang.—Near Holyhead (R. Freer, *E.M.M.*, Vol. XII., p. 13).

351. **A. paludata,** Thnb. **var. imbutata,** Hb. Extremely local.

C.—Wybunbury Moss, c. (F. C. Woodforde). Mr. J. Thorpe records that a specimen was taken at Bowdon many years ago, and Mr. Chas. Oldham captured several on Carrington Moss in July 1875; but the species is quite extinct now at Bowdon, and probably also at Carrington Moss.

CHESIAS, Tr.

352. **C. spartiata,** Fuesl. Local, but often plentiful where broom abounds.

C.—Delamere (*W.L.*); Alderley district, Bromborough, and Hooton (*E.L.*); Chester, two at e.l. 1898 (Do.); White Hall, near Tarporley (Stk.); Great Budworth, l., c. 1902 (Miss Roscoe); Knutsford, r. (Da.); Ashton-on-Mersey, c., but local (Da., Ta., Tp.); Shavington Park 1900 (Th.)

D.—Colwyn (*W.L.*)

353. **C. rufata,** Fb. = **obliquaria,** Bork. Rare and local; the only records are:

C.—Delamere (*W.L.*); ditto, sp. (N.); White Hall, near Tarporley, at e.l. (Stk.)

LOBOPHORA, Curt.

354. **L. carpinata,** Bkh. = **lobulata,** Hb. Recorded only from the Delamere Forest district.

C.—Delamere, f.c., taken by most of the local collectors; Pettypool Wood (Co.)

355. **L. halterata,** Hufn. The only records in the district are:

C.—Rather scarce, Ness; Puddington (*W.L.*)

356. **L. viretata,** Hb. Very rare and local.

C.—Sandle Heath and Goss Moss, near Alderley (H. H. Corbett in *E.L.*)

Car.—In a holly plantation near Penmaenmawr (Po.)

CHEIMATOBIA, Stph.

357. **C. boreata,** Hüb. Recorded only from Cheshire, where it is common in the Delamere Forest district, though local.

C.—Bidston, n.c. (Pr.); Chester, o. at e.l. (A.); ditto, one in 1898 (Do.); Delamere, c. (Da., A., N.); ditto, one in 1900 (H.); White Hall, near Tarporley, a few (Stk.); Little Budworth (N.); Pettypool Wood, near Cuddington, a. (Co.); Knutsford, o. (Da.)

358. **C. brumata,** L. Common everywhere.

TRIPHOSA, Stph.

359. **T. dubitata,** L. Appears to be generally distributed.

C.—Wirral, o. (*W.L.*); Wallasey, n.c. (Pr.); ditto, several in 1900 (H.); Ince Marshes, sp. (N.); Chester (N.); ditto, at e.l. (Do.); ditto, gas lamps, also the Cemetery (A.); Vicar's Cross, a few (P.C.); White Hall, near Tarporley (Stk.); Knutsford, n.c. (Da.); Bowdon (Tp.); Alderley Edge, a., hybernating in the old copper mines (Da.); Stockport, odd specimens at light (J.)

F.—Holywell (*W.L.*); Overton and Rhyl, m.c. (Pe.)

D.—Colwyn (*W.L.*); Cefn Caves (W.G.); Ruthin (W.G., J. E. R. Allen); near Nant Glyn (B.)

Car.—Penmaenmawr, on the mountains (Po.); Capel Curig (A.)

EUCOSMIA, Stph.

360. **E. certata,** Hüb. Only one record.

Car.—Near Deganwy (W.G.)

361. **E. undulata,** L. Found frequently in certain parts of Delamere Forest, but rare elsewhere.

C.—Eastham Wood and Delamere Forest (*E.L.*); ditto (A.); ditto, rather s. (Cr., Da.); ditto, n.c. (J.); ditto, v.c. (P.C.); ditto and Oakmere, sp. (N.); White Hall, near Tarporley (Stk.); Broadheath, near Altrincham, one 1901 (Tp.)

LYGRIS, Hb.

362. **L. prunata,** L. = **ribesiaria,** B. Local and not often met with, but is apparently of wide distribution.

C.—Burton (*W.L.*); Wallasey, s. (Pr.); Little Sutton (Sh.); White Hall, near Tarporley (Stk); Marple and Stockport (*E.L.*); local near Whaley Bridge (J.)

F.—Holywell and Rhyl (*W.L.*); Rhyl (W.G.); ditto, m.c. (Pe.)

D.—Colwyn Bay (N.)

Car.—Bettws-y-Coed (Sh.); near Penmaenmawr, c. (Po.); Llanfairfechan (Ta.); Aber (P. T. Barrand); Abersoch, n.c. (Da.)

363. **L. testata,** L. Common locally.

C.—Wirral (*W.L.*); Wallasey, c., l. on sallow (Pr., M., J.); Noctorum (Sh.); Ince Marshes, c. (N.); Vicar's Cross, n.c. (P.C.); White Hall, near Tarporley (Stk.); Delamere Forest (H., Ta., A., Cr.); ditto, Rudheath and Knutsford, c. (Da.); Hale (Tp.); Taxal (Cr.); Whaley Bridge, c. (J); Wybunbury Bog (Th.)

F.—Cwm Mountain, Bagillt Marsh, c., Mostyn and Loggerheads (*W.L.*); Rhyl, m.c. (Pe.)

D.—Clwyd Hills (W.G.)

Car.—Penmaenmawr, a. (Po.); Abersoch (Da.)

364. **L. populata,** L. Generally common wherever bilberry grows.

C.—Wallasey sandhills, Chester (?), (*W.L.*); Noctorum (Sh.); Storeton Quarry (*E.L.*); Ince Marshes, sp. (N.); Vicar's Cross, near Chester, a few (P.C.); White Hall, near Tarporley (Stk.); Delamere, c. (M., A., P.C., Cr., Da.); Kennel Wood, Sandiway (Co., Da.); Hale and Bowdon (Tp.); Alderley and Staley Brushes (*E.L.*); Macclesfield, p. (R. South); Whaley Bridge, v.c. (Cr., J., Da.)

F.—Loggerheads and Holywell (*W.L.*); Rhyl (Pe., W.G.)

D.—Colwyn Bay (N.); near Nant Glyn (B.)

Car. -- Penmaenmawr, c. (Po.); Carnarvonshire Mountains, running to dark forms (W.G.)

365. **L. associata,** Bkh. = **dotata,** Gn. Local and rather rare.

C.—Puddington and Denhall (*W.L.*); Wallasey (W.G.); ditto, s. (Pr.); Helsby (A.); Delamere, v.c. (P.C.); Alderley and Bowdon (*E.L.*); Stockport, o. (J.)

F.—Rhyl, o. (Pe.)

LARENTIA, Tr. = CIDARIA, Tr.

366. **L. dotata,** L. = **pyraliata,** Hb. Recorded common locally, but is not generally distributed.

C.—Common (*W.L.*, A.); Wallasey, s. (Pr.); Barnston Heath (W.G.); Ince Marshes (N.); Vicar's Cross, near Chester, a few (P.C.); Delamere (Cr., Ta.); ditto, Knutsford, Alderley, c., and Bowdon (*E.L.*); Bowdon (Tp.); Stockport, o. (J.); Macclesfield (R. South.)

F.—Rhyl, o. (Pe.)

D.—Near Nant Glyn (B.)

Car.—Penmaenmawr (Po.)

367. **L. fulvata,** Forst. Moderately common and widely distributed.

C.—Wallasey (Pr., M., J.); Sutton and Ledsham (Sh.); Ince Marshes, sp. (N.); Chester (N.); ditto, c. at e.l. (A.); Vicar's Cross, v.c. (P.C.); White Hall, near Tarporley (Stk.); Delamere (N.); ditto and Knutsford, n.c. (Da.); Hale (Tp.); Stockport, o. (J.); Macclesfield (R. South).

F.—Overton, m.c., and Cwm, o. (Pe.); Rhyl sandhills (W.G.)

D.—Colwyn Bay (N.)

Car.—Deganwy (W.G.); Llanfairfechan (Ta.)

368. **L. ocellata,** L. Common and generally distributed throughout.

369. **L. bicolorata,** Hufn. = **rubiginata,** Hb. Somewhat local and not generally common.

C.—Rock Ferry, Ness, Puddington, Ledsham, Ince, and Chester 1884 (*W.L.*); Chester, one only at e.l. 1900 (A.); Vicar's Cross, f.c. (P.C.); White Hall, near Tarporley, a few (Stk.); Delamere (M.); ditto, c., and Holford Moss (Da.); Audlem (Cr.)

F.—Loggerheads (*W.L.*); Overton, o., and Rhyl, one (Pe.)

D.—Segrwyd, near Nant Glyn (B.)

Car.—Aber (P. J. Barraud).

369a. „ **var. plumbata,** Curt.

C.—Ledsham, s. (*W.L.*)

370. **L. variata,** Schiff. Common in all fir woods.

371. **L. cognata,** Thnb. = **simulata,** Hb. Recorded only from Gloddaeth, Carnarvonshire, by R. Newstead (larvæ fairly common).

372. **L. juniperata,** L. Recorded only from Gloddaeth, Carnarvonshire, by R. Newstead.

373. **L. siterata,** Hufn. = **psittacata,** Schiff. The only records are:

C.—Eastham Wood, on the authority of C. S. Gregson in *E.L*

Car.—Bettws-y-Coed (B.)

374. **L. miata,** L. Local and scarce.

C.—Has been taken in North Birkenhead (*W.L.*); East Cheshire (N.G.); Prenton, v.s. (Pr.); Chester, gas lamps, s. (A.); Macclesfield, a. (R. South).

D.—Llanferres (B.)

Car.—Capel Curig (A. S. Tetley).

375. **L. truncata,** Hufn.
376. **L. immanata,** Hw.
We are quite in agreement with Mr. E. Meyrick's statement in his "Handbook of Lepidoptera" that no distinct line of demarcation can, at present, be drawn between these so-called species. Generally distributed and very common.

377. **L. firmata,** Hb. Either it has been overlooked or else is rare in the district. All the records, with the exception of Mr. Prince's (Bidston), are old ones contained in Mr. Walker's list.

C.—Not abundant Prenton Mount Wood, Haddon Wood, Ness, Puddington, and East Cheshire (*W.L.*); Fir Woods, Bidston (Pr.)

378. **L. munitata,** Hb. Recorded from only one locality.

C.—Occasional in the high-lying district on the borders of Cheshire, between Macclesfield and Buxton (Da.)

379. **L. olivata,** Bkh. Very rare.

C.—Bidston, on the authority of G. A. Almond in *W.L.*; Staley Brushes, r. (Jos. Chappell in *E.L.*)

F.—Overton, one (Pe.)

Car.—Vale of Conway (W.G.); woods above Trefriew (B.); Penmaenmawr (Po.)

380. **L. viridaria,** Fab. = **pectinataria,** Knoch. Common and generally distributed throughout.

381. **L. salicata,** Hb. Local and rare; apparently confined to hilly districts.

D.—Berwyn Mountains (W.G.)

Car.—Bettws-y-Coed and mountains near Conway (W.G.)

382. **L. fluctuata,** L. Abundant everywhere.

383. **L. multistrigaria,** Hw. Generally distributed; common in some places. Recorded from all the counties except Anglesea.

384. **L. didymata,** L. Common everywhere.

385. **L. cambrica,** Curt. = **cambricaria,** Gn. Recorded from one locality only.

C.—Border of Cheshire between Macclesfield and Buxton, c. (Da., J.)

386. **L. montanata,** Schiff. Very common everywhere.

387. **L. suffumata,** Hb. Met with only sparingly.

C.—Wallasey, s. (Pr.); Wirral (*W.L.*); Eastham Wood (*E.L.*); Elton Green, near Ince (Co.); Chester (*W.L.*, N.); Upton, near Chester, c. (A.); Knutsford, r. (Da.); Delamere Forest and Alderley Edge (*E.L.*); Macclesfield (R. South).

F.—Overton, m.c. (Pe.)

D.—Colwyn (*W.L.*); Llangollen (B.)

388. **L. ferrugata,** Clerch. Recorded from all the counties except Anglesea, but is more uncommon than the following species.

C.—Puddington, Birkenhead, and Wallasey sandhills (*W.L.*); Wallasey, one in 1900 (H.); Noctorum, n.u. (Pr.); Little Sutton (Sh.); Chester gas lamps and Curzon Park, Chester, s. (A.); White Hall, near Tarporley (Stk.); Delamere (M.); ditto, three in 1899 (H.); Dunham (Ta.); Stockport, o. (J.); Macclesfield (R. South).

F.—Overton, c., Rhyl and Cwm, c. (Pe.); Nant-y-ffrith Valley (N.)

D.—Pensarn and Colwyn Bay (N.); Llangollen (B.)

Car.—Trefriew (*W.L.*); coast, o. (J.); Abersoch (Da.)

389. **L. unidentaria,** Hw. Common everywhere. Mr. A. O. Walker states: "Chester, very common and double-brooded; the second brood occurring at the end of July and beginning of August."

390 **L. designata,** Rott. = **propugnata,** F. Appears to be widely distributed, though found only sparingly in most parts.

C.—Wirral, Chester, c., and apparently double-brooded; occurring again in mid-August (*W.L.*); ditto, c. generally (A.); Ince, s. (N.); White Hall, near Tarporley (Stk); Knutsford, n.c. (Da.); Delamere (M., T.); ditto, Dunham Park, Carrington Moss, Claughton, and Saughall (*E.L.*); Macclesfield (R. South).

F.—Overton, m.c., Rhyl and Cwm, o. (Pe.)

D.—Colwyn Bay, frequent (N.)

Car.—Near Beddgelert (B.)

391. **L. fluviata,** Hb. Of very rare occurrence.

C.—Birkenhead, r., Burton, n.u. (*W.L.*); Birkenhead, a specimen taken by Mr. Diggles in October 1857, and recorded in the Proceedings of the Northern Entomological Society (*Zoologist*, 1858, Vol. XVI., p. 5771);

Wallasey sandhills, a single specimen (W. Johnson); and a specimen captured by Mr. E. R. Curzon on the border of the sandhills near Wallasey Village, Sept. 30th, 1880 (*E.L.*); one taken by A. G. Almond off street lamp, North Birkenhead (Pr.); one at e.l., Chester, 26th Oct., 1900, by Dr. H. Dobie.

F.—Rhyl, one taken at window light, 2nd Aug., 1900, by Miss Perkins.

392. **L. vittata,** Bkh. = **lignata,** Hb. Very local, and apparently confined to marshy places.

C.—Bidston Marsh and Ness (*W.L.*); Otterspool, Chorlton Flat near Stretford, Ashton-on-Mersey, Warburton, and Heatley, n.c. (*E.L.*); Chester (N.); Sealand Road pond, near ditto, c. but local, two broods (A.)

D.—Wrexham (G. Frater); Colwyn Bay (N.)

Car.—Abersoch, c. (Da.); f.c. on coast 1900 (J.)

393. **L. dilutata,** Bkh. Generally distributed and often plentiful.

C.—Tranmere and Puddington (*W.L.*); Bidston, n.c. (Pr.); Little Sutton (Sh.); Ince Marshes, sp. (N.); Chester, sp. (Do., N.); ditto, c. at gas lamps (A.); White Hall, near Tarporley (Stk.); Delamere Forest, p. (Cr., Da., A.); Knutsford, c. (Da.); Bowdon (Tp.); Stockport, f.c. (J.)

F.—Holywell (*W.L.*); Overton, o. (Pe.)

D.—Colwyn Bay (N.); Llangollen (Ta.)

394. **L. autumnata,** Bkh.

C. — Recorded from Delamere Forest (Gregson) through Mr. L. B. Prout and by Mr. T. G. Mason.

394a. „ **var. filigrammaria,** H.S. Local and scarce.

C.—Bidston Hill (*W.L.*); Ledsham (Sh.); Curzon Park, near Chester, one at sugar, s. (A.); Greenfield (Tp.); Whaley Bridge (Da.)

F.—Loggerheads (*W.L.*)

D.—Llangollen (Ta.)

395. **L. cæsiata,** Lang. Common on the high moorlands in North Wales and in the extreme east of Cheshire.

C.—Alderley Edge, r. (*E.L.*); Staley Brushes, a. (*E.L.*); Ludchurch Moor, Macclesfield (R. South); Taxal (Cr.); c. on the borders of Cheshire between Macclesfield and Buxton (Da., J.)

F.—Cwm Mountain and Loggerheads (*W.L.*)

D.—Moel Fammau (*W.L.*); ditto, p. on the Cilcen side (A.); Clwyd Hills and all along the Berwyn Mountains (W.G.); Llangollen (B.); Colwyn Bay (N).

Car.—Penmaenmawr, a. (Po.); v.a. over the Carnarvonshire Mountains (W.G.)

396. **L. galiata,** Hb. Local; found generally on and near the coast, but recorded also in a few inland localities.

C.—Ness and Burton (*W.L.*); Wallasey, taken by most who have sent in records; White Hall, near Tarporley (Stk.); Bowdon, one (Tp.); Alderley, Cheadle Hulme, and Staley Brushes (*E.L.*); Macclesfield (R. South).

F.—Rhyl, c. (Pe.); ditto and Loggerheads (*W.L.*); The Leet (A.)

D.—Colwyn Bay (N.)

Car.—Deganwy (W.G.); Penmaenmawr, c. (Po., Ta.); Abersoch (J., Da.)

Ang.—Near Holyhead 1900 (R. Freer, *E.M.M.*, Vol. XII., p. 13).

397. **L. rivata,** Hb. Being not easily distinguished from the following common species, it has probably been overlooked:

C.—Wirral (?), (W.G. in *W.L.*); Birkenhead, c. (Pr.)

F.—Loggerheads (*W.L.*); Overton and Rhyl (?), (Pe.)

Car.—Deganwy (W.G.)

398. **L. sociata,** Bkh. = **subtristata,** Hw. Very common everywhere.

399. **L. unangulata,** Hw. Found in a few localities only.

C.—Flaybrick Hill, Ledsham, Tranmere, and Puddington, n.c. (*W.L.*); Flaybrick Hill and Noctorum (*E.L.*)

Car.—Near Deganwy (W.G.); near Abersoch, r. (Da.)

400. **L. picata,** Hb. Very rare and local.

D.—Bathafarn, near Ruthin (*W.L.*)

Car.—About rocks between Penmaenmawr and Conway (Po.)

401. **L. albicillata,** L. Local and not often met with, except in parts of Delamere Forest, where it is not uncommon.

C.—Eaton Park, near Chester (*W.L.*); White Hall, near Tarporley, one (Stk.); Delamere Forest (J. Thompson, J., Ta., Da.); ditto, c. in 1900 (Th.); ditto, one

1900 (H.); ditto, five or six in 1900 (Do.); Holford Moss, u. (Da.); Hale and Dunham (Tp.); Alderley, r., and Marple (*E.L.*); Stockport, odd specimens (J.)

Car.—Bettws-y-Coed (Bl.)

402. **L. procellata,** F. One specimen taken at High Legh, Cheshire, about 1893, by John Thorpe.

403. **L. tristata,** L. Rare and local.

C.—Recorded from Castle Mill by Joseph Chappell in *E.L.* Most likely extinct there now.

F.—Loggerheads (*W.L.*)

D.—Near Bala (N.)

Car.—Trefriew (*W.L.*); Capel Curig (B.)

404. **L. affinitata,** Stph. Apparently not common in the district, except at Colwyn Bay.

C.—Wirral (*W.L.*); Wallasey, o. (*E.L.*); Noctorum, s. (Pr.)

F.—Holywell, Cwm Mountain, and Llyn Helig (*W.L.*)

D.—Colwyn Bay (N.); ditto, v.c. in 1893 (J.); Abergele (G. Frater).

Car.—Abersoch (Da.)

405. **L. alchemillata,** L. Widely distributed, but local and not common generally.

C.—Patrick Wood near Bromborough Mill, Puddington, and Chester (?), (*W.L.*); Birkenhead, n.u. (Pr.); Wallasey, r., and Alderley, c. but local (*E.L.*); Dunham (Ta.); Macclesfield (R. South); Edge, near Malpas, one (F.H.W.D.)

F.—Loggerheads (*W.L.*)

D.—Colwyn (*W.L.*, N.)

Car.—Near Llandudno (Po.)

406. **L. unifasciata,** Hw.

C.—Recorded from Wallasey sandhills (scarce) by Mr. N. Cooke in *W.L.*, but the species has not been noticed there for many years.

Car.—Mr. Willoughby Gardner states it has been taken near Deganwy.

407. **L. albulata,** Schiff. Locally common throughout. "Common wherever the food-plant of the larva, yellow-rattle *(Rhinanthus crista-galli)*, grows" (*E.L.*)

408. **L. testaceata,** Don. = **sylvata,** Hb. Very rare.

C.—Recorded from East Cheshire on the authority of N. Greening (*W.L.*); Bromborough Woods (Gregson); Castle Mill and Delamere (J. Chappell in *E.L.*)

D.—Colwyn Bay (O. Whittaker).

409. **L. obliterata,** Hufn. = **heparata,** Hw. Local and rare.

C.—Rock Ferry, Puddington, Burton, and East Cheshire, n.v.c. (*W.L.*); Bidston, Bramall, Marple, and Delamere (*E.L.*)

F.—Overton, o. (Pe.)

410. **L. luteata,** Schiff. Local and not often met with.

C.—Burton and Puddington, s. (*W.L.*); Delamere, sp. (Da., A.); ditto, o. (N.); ditto, Bidston, Bramall (c. but local), and Marple (*E.L.*)

F.—Holywell (*W.L.*); Overton, m.c., and Cwm, o. (Pe.)

411. **L. flavofasciata,** Thnb. = **decolorata,** Hb. Fairly common throughout. Large and strongly marked in Anglesea (R. Freer). Found generally wherever campion (*Lychnis diurna*) grows.

412. **L. bilineata,** L. Abundant almost everywhere.

413. **L. sordidata,** F. = **elutata,** Hb. Common almost everywhere. In the Kennel Wood, an outlying part of the Delamere Forest district, imagines from larvæ feeding on bilberry are of a uniform blackish-brown colour (**ab. infuscata,** Stgr.)

414. **L. autumnalis,** Ström. = **trifasciata,** Bkh. and **impluviata,** Hb.

C.—In most woods in Wirral (*W.L.*); Chester, c., o. at e.l. (A.); Plumbley, one 1897 (Da.); Dunham (Ta.); Stockport, but n.c. (J.); Macclesfield, s. (R. South).

F.—Llyn Helig and Loggerheads (*W.L.*); Overton, o. (Pe.)

D.—Abergele (N.)

Car.—Aber (P. J. Barrand).

415. **L. ruberata,** Frr. Local, but fairly common where it does occur (*E.L.*)

C.—Bidston Marsh (*W.L.*); Wallasey sandhills (*E.L.*); Flaybricks, n.s. (Pr.); near Birkenhead, c. but local (J., M.); Rock Ferry, c. 1874 (W.G.); West Kirby and Ledsham (Sh.); Helsby, s. (N.); Delamere, s. (A.); Macclesfield, r. (*E.L.*)

F.—Holywell (*W.L.*)

D.—Abergele and Colwyn Bay (N.)

416. **L. silaceata,** Hb. Not often met with.

C.—Little Sutton (Sh.); Delamere Forest and Marple (*E.L.*); Hale (Tp.); N. Cheshire (N.G.)

F.—Rhyl, o. (Pe., W.G.); Nant-y-ffrith (N.)

D.—Colwyn (*W.L.*); ditto, c. (N.)

Car.—Llanfairfechan, n.c. (Ta.)

417. **L. corylata,** Thnbg. Somewhat local, bnt generally fairly plentiful where it occurs.

C.—Puddington, s. (*W.L.*); Birkenhead, s. (Pr.); Eastham Wood (*E.L.*); Delamere, f.c., recorded by all the local collectors; Pettypool Park (Co.); White Hall, near Tarporley (Stk.); Holford Moss (Da.); Warburton (Tp.); Alderley district, c., and Marple (*E.L.*)

F.—Overton and Cwm, o. (Pe.)

D.—Vale of Clwyd (W.G.); Colwyn Bay, c., and Abergele (N.)

418. **L. badiata,** Hb. Fairly common and generally distributed.

C.—Common among dog-roses; Wirral (*W.L.*); Wallasey, one 1900 (H.); Noctorum, n.u. among *Rosa canina* (Pr.); Sutton (Sh.); Ince Marshes and Upton near Chester, c. at sallows (N.); Chester (*W.L.*, Da.); ditto, generally c. at gas lamps (A., Do.); White Hall, near Tarporley (Stk.); Cuddington (Da.); Knutsford and Hale (Tp.); Stockport, f.c. (J.)

F.—Holywell and Loggerheads (*W.L.*); Overton, m.c., Rhyl, and Cwm, o. (Pe.)

D.—Colwyn Bay, c. at sallows (N.)

419. **L. nigrofasciaria,** Goeze. = **derivata,** Bkh. Local and rather uncommon.

C.—Tranmere, rather s. (*W.L.*); Ledsham (Sh.); ditto, c. (*W.L.*); Bidston Hill, o., and between Oxton and Prenton (*E.L.*); Upton near Chester, and Sealand, sp. distributed (A.); Chester, r. (Da.); Delamere (*E.L.*); ditto, one only (J.); ditto, once near "Abbey Arms" (Co.); Cheadle Hulme and Alderley (*E.L.*)

F.—Holywell (*W.L.*); Overton, m.c., and Cwm, o. (Pe.)

Car.—Deganwy (W.G.)

420. **L. comitata,** L. Somewhat local and not seen commonly.

C.—Wallasey (M., H., J.); ditto, n.u. (Pr.); ditto and Denhall (*W.L.*); Egremont and Rock Ferry (*E.L.*);

Chester (*W.L.*); ditto, n.v.c. at e.l. (A.); Knutsford (Da.); Dunham (Ta.); Bowdon and Alderley district (*E.L.*); Stockport, o. (J.)

F.—Holywell (*W.L.*)

D.—Colwyn Bay (N.)

ASTHENA, Hb.

421. **A. candidata,** Schiff. Local and only occasionally met with.

C.—Wallasey and Bidston, rather s. (*W.L.*); Little Sutton (Sh.); Eastham and Hooton (*E. L.*); Ince Marshes, sp., and Chester (N.); Holford Moss, n.c. (Da.); Delamere Forest, Bollin Valley near Castle Mill, and Marple (*E.L.*); Shavington Park 1900 (Th.)

F.—Holywell (*W.L.*)

D.—Colwyn Bay, c. (N.); Llangollen (B.)

TEPHROCLYSTIA, Hb. = EUPITHECIA, Curt.

422. **T. oblongata,** Thnb. = **centaureata**, F. Generally distributed and common.

C.—Bidston (*W.L.*); Wallasey (*W.L.*, M., Pr., Da., Co., J.); Chester, rather c. at e.l. (Do., A.)

F.—Rhyl, c. (Pe.)

D.—Colwyn Bay (N.)

Car.—Deganwy (Da.)

423. **T. linariata,** F. Local and not often met with.

C.—Bidston and Tranmere (*W.L.*); Barnton, Bidston, Heswall, and West Kirby (W.G.); Wallasey (M.); ditto, o. (Pr., J.); New Brighton and Delamere (*E.L.*); Chester, one at e.l. 1900 (Do.)

D.—Colwyn (*W.L.*); Vale of Clwyd (W.G.)

Car.—Near Deganwy (W.G.); Penmaenmawr (Po.)

424. **T. pulchellata,** Stph. Fairly common where Foxglove grows freely.

C.—Prenton Mount Wood, Rock Ferry, Ness, and Burton (*W.L.*); Thurstaston, Heswall, and West Kirby (W.G.); Chester, two or three at e.l. 1899 (Do.); Delamere (H.); ditto, l., c. (A., M.); Holford Moss and Knutsford (Da.); ditto, Alderley, c., Dunham Park, and Castle Mill (*E.L.*); Bowdon (Tp.); Stretton Moss, Arley, l. (Co.); Stockport and Whaley Bridge (J.); Macclesfield (R. South); Edge, near Malpas, l., c. (F.H.W.D.)

D.—Vale of Clwyd (W.G.)

Car.—Vale of Conway (W.G.); Penmaenmawr 1902 (Da.); coast 1900 (J.); Abersoch, c. (Da.)

425. **T. indigata,** Hb. Fairly common in pine woods in Cheshire.

C.—Prenton Mount Wood, Ness, and Burton (*W.L.*); Bidston, Rudheath, Dunham Park, Lindow Common, and Alderley (*E.L.*); Delamere Forest (*E.L.*, Da., Cr.); Abbot's Moss Wood (Co.)

426. **T. venosata,** F. Local, but not uncommon where *Silene maritima* grows.

C.—Denhall, one (*W.L.*); Hilbre Island, c. (*W.L.*); ditto, l. (Sh.); ditto, a. (W.G.); Chester, two or three at e.l. (Do.); Sealand, near Chester, c. as l. and imago (A.); White Hall, near Tarporley (Stk.); Macclesfield (R. South).

F.—Cwm, c. (Pe.)

D.—Colwyn, rather c. (*W.L.*); ditto and Abergele (N.)

Car.—Near Llandudno, frequent (N.); coast 1900 (J.); Abersoch, c. as l. (Da.)

Ang.—Near Holyhead (R. Freer, *E.M.M.*, Vol. XII., p. 13).

427. **T. pimpinellata,** Hb.

C.—Wallasey (W. Johnson in *E.L.*)

F.—Miss Perkins puts (?) for Rhyl and Overton captures.

428. **T. distinctaria,** H.S. = **constrictata,** Gn. Very rare.

C.—Near Birkenhead and Burton (*W.L.*)

D.—Colwyn (?), (*W.L.*)

Car.—Criccieth (W.G.)

429. **T. expallidata,** Gn.

Car.—"Said to have been taken near Conway" (W.G.)

430. **T. assimilata,** Gn. Not uncommon.

C.—Wirral (*W.L.*); ditto, o. (W.G.); Bidston, c. on hops (Pr.); ragwort flowers on the coast (*E.L.*); Curzon Park, Chester, at gas lamps (A.); Statham, near Lymm, among wild hops (Co.); Knutsford (Da.); Bowdon and Baguley (*E.L.*); near Wilmslow, l. c. on wild hop (J.)

F.—Rhyl, o. (Pe.)

D.—Colwyn Bay, frequent (N.)

431. **T. absinthiata,** Cl. Common generally in Cheshire; not recorded from N. Wales.

C.—Wallasey, c. (Pr.); Wirral and Chester, c. (*W.L.*); ditto, c. at e.l. (A., N.); Tarporley Road, Cuddington, on ragwort (Co.)

432. T. **goossensiata,** Mabille. = **minutata,** Gn. "Fairly common wherever heather grows, as on the moors and mosses" (*E.L.*)

C.—East Cheshire (*W.L.*); Whitegate Heath (Co.); Rudheath, c. (Da.); Dane's Moss, near Macclesfield (R. South).

Car.—Penmaenmawr, on the mountains (Po.)

433. T. **albipunctata,** Hw. Local.

C.—Castle Mill and Knutsford (*E.L.*)

433a. „ **var. angelicata,** Bar.

C.—Holford Moss, c. (Da.)

434. T. **vulgata,** Hw. Common and generally distributed.

C.—Wirral (*W.L.*); Bidston, c. (Pr.); Chester (*W.L.*); ditto, c. at e.l. (A.); Edge, near Malpas, c. (F.H.W.D.); Knutsford and Holford Moss, c. (Da.); Hale (Tp.); Macclesfield (R. South).

F.—Holywell (?), (*W.L.*)

D.—Colwyn Bay, frequent (N.)

Car.—On the coast 1900 (J.)

435. T. **virgaureata,** Dbld. Not generally common.

C.—Wallasey, n.u. (Pr.); ditto, on ragwort (Co.); ditto, c., Bidston Hill and Staley Brushes, n.c. (*E.L.*); Tarporley Road, near Abbot's Moss (Co.)

436. T. **trisignaria,** H.S. Recorded from Rhyl by Miss Perkins, on the authority of Mr. C. G. Barrett, who states that the insect sent him for identification is "apparently" this species.

437. T. **lariciata,** Freyer. Local and rare.

C.—East (N.G.); Abbot's Moss, a few (Co.); Alderley, local (*E.L.*)

F.—Cwm, o. (Pe.)

438. T. **castigata,** Hb. Fairly common locally.

C.—Wirral (*W.L.*); c. round Birkenhead (Pr.); c. about Chester and at e.l. (A.); Hartford (*E.L.*); Cuddington and Holford Moss (Da.); Alderley, a. (*E.L.*); Macclesfield (R. South).

F.—Cwm Mountain (*W.L.*)

D.—Bathafarn and Colwyn (*W.L.*); Colwyn Bay, frequent (N.)

Car.—Abersoch 1900 (Da.)

439. T. **subnotata,** Hb. Not common.

C.—Wallasey, Birkenhead, and Denhall, s. (*W.L.*); Prenton (*E.L.*); Chester, at e.l. 1900 (Do.)

F.—Rhyl, o. (Pe.)

D.—Colwyn (*W.L.*)

440. T. **helveticaria,** Boisduval. "Said to have been taken on the junipers at Gloddaeth, near Llandudno" (W.G.)

441. T. **satyrata,** Hb. Rather scarce.

C.—Near Birkenhead and Burton (*W.L.*); Ince Marshes (N.); Hale (Tp.); Bowdon (*E.L.*)

F.—Llyn Helig (*W.L.*)

D.—Colwyn Bay (A. O. Walker, N.)

Car.—Mountain near Conway (W.G.)

442. T. **succenturiata,** L. Not common.

C.—Wallasey, n.c. (Pr.); ditto, Tranmere, Puddington, and Chester (*W.L.*); Bidston, Bromborough, and Dunham, r. (*E.L.*); Cuddington, n.c. (Da.)

F.—Rhyl, one (Pe.)

D.—Colwyn Bay, one (N.)

Car.—Deganwy (W.G.)

442a. „ **var. (?) subfulvata,** Haw. Fairly common, but local.

C.—Wallasey, f.c. (Pr., Co., J.); ditto, one in 1899 (H.); ditto and Burton (*W.L.*); Bromborough (*E.L.*); Chester, rather c. at e.l. (Do., A.); Knutsford, u. (Da.); Bowdon (Tp.); ditto and Alderley district, c. (*E.L.*); Macclesfield, l. on yarrow (R. South).

F.—Holywell and Llyn Helig (*W.L.*); Rhyl, o. (Pe.)

D.—Vale of Clwyd (W.G.)

Car.—Penmaenmawr (Po.)

443. T. **valerianata,** Hb. The only records are:

C.—Arley (Co.); East Cheshire (N.G. in *W.L.*)

444. T. **pygmæata,** Hb. Very rarely met with.

C.—Dee Marsh, near Puddington (*W.L.*); Castle Mill, on the authority of Jos. Chappell (*E.L.*); North-east Cheshire (N.G.)

D.—Colwyn (*W.L.*)

445. T. **ultimaria,** Boisdl. The only record is:

C.—Gas lamps, Curzon Park, Chester (A.)

446. **T. tenuiata,** Hb. East Cheshire, on the authority of N. Greening (*W.L.*); recorded from "North Wales" by Mr. J. Taylor.

447. **T. inturbata,** Hb. = **subciliata,** Gn.

D.—Colwyn (?), (*W.L.*)

448. **T. nanata,** Hb. Occurs on most heaths.

C.—Bidston, n.u. (Pr.); Bidston Hill, Claughton Fir Wood, and Prenton Mount Wood (*W.L.*); Delamere Forest (Th., A., Da.); Whitegate Heath (Co.); ditto, c. in 1902 (Da.); Bowdon (Tp.); Macclesfield (R. South); Goyt's Clough (Da.)

D.—Moel Fammau (*W.L.*); Llangollen (B.)

Car.—Trefriew (*W.L.*); Penmaenmawr, a. on the mountains (Po.)

Ang.—Near Holyhead 1900 (R. Freer, *E.M.M.*, Vol. XII., p. 13).

449. **T. innotata,** Hufn. Scarce.

C.—Rock Ferry, Puddington, and East Cheshire, s. (*W.L.*); a few on the sandhills (C. S. Gregson in *E.L.*); one at Styal (Jos. Chappell in *E.L.*)

449a. „ **var. fraxinata,** Crewe. North-east Cheshire (N.G.)

450. **T. abbreviata,** Stph. Not very general.

C.—Eastham Wood, Puddington, and East Cheshire (*W.L.*); Chester, at gas lamps (A.); on the border of Cheshire between Macclesfield and Buxton (Da.)

F.—Rhyl, c. (Pe.)

451. **T. exiguata,** Hb. It is stated in *Ellis's List* to be common and generally distributed, but the species is not mentioned in any of the recent lists for Cheshire and N. Wales; the only records are:

C.—Puddington and East Cheshire (*W.L.*)

452. **T. pumilata,** Hb. Local, but generally common where it occurs.

C.—Bidston Hill (*W.L.*, *E.L.*); ditto, c. sometimes (Pr.); Claughton Fir Wood and Haddon Wood (*W.L.*); Wallasey, New Brighton, Delamere, a., and Alderley district, c. (*E.L.*); Rudheath (Da.)

F.—Rhyl, o. (Pe.)

Car.—Penmaenmawr (Po.); Abersoch, c. (Da.)

CHLOROCLYSTIS, Hb. = EUPITHECIA, Curt.

453. **C. rectangulata,** L. Not common generally.

C.—Chester, East Cheshire, c. at Denhall, o. elsewhere in Wirral (*W.L.*); Chester, two at e.l. 1900 (Do.); Stockport, odd specimens (J.); Knutsford, **ab. nigrosericeata,** Hw., o. (Da.)

F.—Rhyl, o. (Pe.)

Car.—Conway (W.G.); Abersoch (Da.)

COLLIX, Gn.

454. **C. sparsata,** Tr. The only records are:

C.—Delamere Forest (S. J. Capper in *E.L.*); East Cheshire (N.G. in *W.L.*)

BOARMIINÆ.

ABRAXAS, Leach.

455. **A. grossulariata,** L. Abundant everywhere.

456. **A. sylvata,** Sc. = **ulmata,** F. Widely distributed, though very local. Generally plentiful where it occurs.

C.—Sutton, v.a. in elm wood; Storeton, o. (W.G.); a., July 1881, in a wood near Poole, Hooton—now destroyed by Ship Canal (Sh.); Delamere (N., J. Thompson, Da.); ditto, one about 1895 (H.); ditto, but very local (J.); White Hall, near Tarporley, one (Stk.); Hale, very local (Tp.); Stockport, o. (J.)

F.—Overton, local (Pe.)

D.—Colwyn Bay, f.c. (N.)

Car.—Bettws-y-Coed (Bl.); near Deganwy, l. very destructive to elm foliage (W.G.)

457. **A. marginata,** L. Common and generally distributed throughout.

458. **A. adustata,** Schiff. Of very rare occurrence in the district. The only records are:

F.—Overton, one (Pe.)

D.—Colwyn Bay 1884 (*W.L.*); ditto and Abergele (N.); Llangollen (B.)

BAPTA, Stph.

459. **B. bimaculata,** F. = **taminata,** Hb. Recorded only from Lligwy (Anglesea) by Lord Boston.

460. **B. temerata,** Hb. Local and, as a rule, scarce.

C.—Eastham Wood, Chester (Miss Smith) and East Cheshire (*W.L.*); Chester, one 1901 (A.); Delamere

Forest, c. near the "Blue Cap" Inn (J. C. Melvill in *E.L.*); Pettypool Wood, May 1851 (N. Cooke in *Zoologist*, Vol. X., p. 3517).

F.—Rhyl, one (Pe.)

D.—Colwyn (*W.L.*, N.)

DEILINIA, Hampson = CABERA, Tr.

461. **D. pusaria,** L. Very common and generally distributed.

461a. „ **var. rotundaria,** Haw. Bred from Delamere Forest larvæ (Da.)

462. **D. exanthemata,** Sc. Generally distributed, though not so common as the preceding species.

NUMERIA, Dup.

463. **N. pulveraria,** L. Local and rarely met with.

C.—Scarce—Claughton, Tranmere, Rock Ferry, Eastham Woods, Ness, Newton Lane near Chester (*W.L.*); Prenton, Oxton, Storeton, Delamere, and Bowdon, r. (*E.L.*)

F.—Holywell (*W.L.*); Rhyl, o. (Pe.)

D.—Colwyn (*W.L.*); ditto and district, sp. (N.); Llangollen (B.)

Car.—Vale of Conway (W.G.)

ELLOPIA, Tr.

464. **E. prosapiaria,** L. = **fasciaria,** Schiff. Not uncommon in most large fir woods.

C.—Prenton, Ness, and Burton, s. (*W.L.*); Prenton (Sh.); Bidston (Pr.); ditto and Storeton fir woods (W.G.); Chester, at e.l. (A.); White Hall, near Tarporley (Stk.); Delamere, by all the local collectors; Abbot's Moss and Kennel Woods (Co.); Rudheath, c. (Da.); Alderley (*E.L.*)

F.—Llyn Helig, Cwm Mountain, Loggerheads, and wood near Bagillt (*W.L.*); Cwm, one (Pe.)

D.—Near Ruthin (W.G.); Llandulas (P.C.)

Car.—Bettws-y-Coed (W.G.); ditto, one (Pe.)

METROCAMPA, Latr.

465. **M. margaritata,** L. Generally distributed; fairly common in some places.

ENNOMOS, Tr. = EUGONIA, Hb.

466. **E. alniaria,** L. = **tiliaria,** Bkh. Of general occurrence, but not abundant.

C.—Claughton and Clifton Parks, Birkenhead, and

Chester (*W.L.*); Oxton and Rock Ferry (W.G.); Wallasey, s. (Pr.); ditto, one in 1899 (H.); Chester, c. at e.l. (Do., A.); White Hall, near Tarporley (Stk.); Knutsford, o. (Da.); Stockport, at light 1900 (J.)

F.—Overton and Rhyl, m.c. (Pe.)

D.—Ruthin (W.G.)

Car.—Deganwy (W.G.)

Ang.—Lligwy (Ld. B.)

467. **E. fuscantaria,** Haw. Has been attracted to electric lamps freely at Chester.

C.—Upton Valley and North Birkenhead, s. (*W.L.*); Bidston (*E.L.*); Chester, at light (N.); ditto, c. at gas and e.l. (A.); ditto, especially in 1898 (Do.); Knutsford, one larva 1901 (E. Roscoe); White Hall, near Tarporley, one 1901 (Stk.)

468. **E. erosaria,** Hb. Rather scarce.

C.—Tranmere and Rock Ferry, s. (*W.L.*); Wallasey, s. (Pr.); Oxton (Sh.); Bidston, Upton, and Dunham Park (*E.L.*); Chester, n.u. at e.l. (Do.); ditto, s. at gas lamps (A.); White Hall, near Tarporley, one (Stk.); Ollerton, near Knutsford, one 1900 (Da.)

SELENIA, Hb.

469. **S. bilunaria,** Esp. = **illunaria,** Hb.
469a. „ **var. juliaria,** Esp.
} Common and generally distributed throughout.

470. **S. lunaria,** Schiff. Rarely met with.

C.—Rock Ferry and Puddington, s. (*W.L.*); Chester, n.u. at e.l. (Do., A.); White Hall, near Tarporley, one at e.l. 1901 (Stk.); Delamere Forest, Cheadle Hulme, and Bramall (*E.L.*)

F.—Holywell, s. (*W.L.*); Overton, one (Pe.)

HYGROCHROA, Hb. = PERICALLIA, Stph.

471. **H. syringaria,** L. Appears to be widely distributed, but is by no means plentiful, except in a few localities.

C.—Denhall, s., and Newton, near Chester (*W.L.*); Chester, s. (A.); ditto, four at e.l. 1899 and 1900 (Do.); Ince Marshes, s., and Manley (N.); Delamere, one 1900 (H.); White Hall, near Tarporley, a few (Stk.); Holford Moss, one (Da.); Sale, v.s. (Tp.); Alderley, r. (*E.L.*)

F.—Holywell (*W.L.*); Overton, m.c. (Pe.)

D.—Colwyn Bay (N.)

Car.—Conway Valley, c. (Bl.)

GONODONTIS, Hb. = ODONTOPTERA, Stph.

472. **G. bidentata,** Cl. Common and generally distributed; abundant in East and Mid-Cheshire.

HIMERA, Dup.

473. **H. pennaria,** L. Not at all common.

C.—North Birkenhead, Eastham Wood, Ness, and Puddington (*W.L.*); Birkenhead Park, never c. in any stage (Pr.); Ince Marshes, s. (N.); Chester, f.c. (N.); ditto, two or three at lamps (Do.); ditto, c. on south side at gas lamps (A.); White Hall, near Tarporley (Stk.); Delamere (M., J., Da.); ditto, two in 1900 (H.); Knutsford (Da.); Alderley district (*E.L.*); Dunham Park (Tp.)

F.—Overton, o. (Pe.)

Car.—Bettws-y-Coed, o. (Pe.); ditto and near Conway (W.G.)

CROCALLIS, Tr.

474. **C. elinguaria,** L. Found throughout; often common.

OURAPTERYX, Leach.

475. **O. sambucaria,** L. Generally distributed; common in many places.

C.—Wirral, a. (Sh.); Wallasey (M.); ditto and Noctorum, c. (Pr.); Ince Marshes, s. (N.); Chester (N.); ditto, a. at e.l. (Do., A.); Vicar's Cross, v.c. (P.C.); White Hall, near Tarporley (Stk.); Delamere, c. (H.); Knutsford, o. (Da.); Hale (Tp.); Stockport, f.c. (J.); Macclesfield (R. South).

F.—Overton, Cwm, and Rhyl, c. (Pe.)

D.—Vale of Clwyd, a. (W.G.)

Car.—Deganwy and Vale of Conway, a. (W.G.); Llanfairfechan (Ta.); near Menai Bridge, c. (Po.); Abersoch, c. (Da.)

EURYMENE, Dup.

476. **E. dolabraria,** L. Only odd specimens occasionally seen.

C.—Rock Ferry and Eastham Wood, s. (*W.L.*); Wallasey, at light (*E.L.*); Chester, two at e.l. 1900 (Do.); White Hall, near Tarporley, a few at e.l. (Stk.); Delamere, at light (N.); ditto, r., Knutsford, r., Dunham Park and Alderley (*E.L.*); Hale, r. (Tp.)

F.—Overton, one bred (Pe.)

D.—Llandulas 1902 (P.C.)

Car.—Bettws-y-Coed (B.)

OPISTHOGRAPTIS, Hb. = RUMIA, Dup.

477. **O. luteolata,** L. = **cratægata,** L. Common everywhere.

EPIONE, Dup.

478. **E. apiciaria,** Schiff. Occurs sparingly.

C.—Wallasey, Rock Ferry, Denhall, and Puddington, n.c. (*W.L.*); Wallasey, odd specimens (J.); ditto, two in 1899 (H.); Hoylake, n.u. (Pr.); Newton-cum-Larton (Da.); Ledsham (Sh.); Ince Marshes, sp. (N.); Chester (*W.L.*, A.); ditto, n.u. at e.l. usually females (Do.); Sealand, near Chester (A.); Hale (Tp.)

F.—Holywell and Loggerheads (*W.L.*); Rhyl, o. (Pe.)

D.—Colwyn Bay (N.); near Ruthin (W.G.)

Car.—Near Conway (W.G.)

VENILIA, Dup.

479. **V. macularia,** L. Local. Absent from the greater part of the district.

C.—One taken in garden at White Hall, near Tarporley (Stk.)

D.—Colwyn Bay, very local (N.)

Car.—Capel Curig (B.); Pass of Llanberis (Da.)

SEMIOTHISA, Hb. = MACARIA, Curt.

480. **S. notata,** L. Recorded in *Ellis's List* as rare in the neighbourhood of Alderley, Cheshire, on the authority of Mr. H. H. Corbett.

481. **S. liturata,** Cl. Fairly common in most pine woods. Very dark forms are taken occasionally at Delamere Forest and Rudheath.

C.—Prenton Mount Wood and Haddon Wood, rather s. (*W.L.*); Bidston (Pr.); Parkgate (W.G.); Chester, one at e.l. 1900 (Do.); Delamere, by all local collectors; White Hall, near Tarporley (Stk.); Abbot's Moss Wood (Co.); Rudheath (Da.); Dunham (Tp.); Alderley (*E.L.*); Goyt's Clough (Da.)

F.—Woods near Llyn Helig (*W.L.*); Cwm, o. (Pe.)

HYBERNIA, Latr.

482. **H. rupicapraria,** Hb. Recorded as common throughout Cheshire and Flintshire. The omission of records from the other counties is probably due to the absence of resident collectors.

483. **H. leucophæaria,** Schiff. Common and very varied in oak woods in Cheshire. Probably not recorded from the

Welsh counties (excepting Flintshire) for the reason before-mentioned.

C.—Prenton, Eastham, and Patrick (near Bromborough Mills) woods, Ness, and Puddington (*W.L.*); Eastham Wood (*E.L.*); Chester, at e.l. (Do., Rev. O. P. Fisher); Eaton Drive, near Chester (A.); White Hall, near Tarporley, c. (Stk.); Delamere, a., by all local collectors; Tatton Park, near Knutsford, a. (Da.); Dunham Park, Alderley, and Bramall (*E.L.*); Stockport, o. (J.); Shavington Park (Th.)

F.—Overton, c. (Pe.)

484. **H. aurantiaria,** Esp. Local and apparently rather scarce.

C.—Denhall and Puddington, s. (*W.L.*); Chester, at e.l. (N.); ditto, s. (A.); Delamere Forest, local and n.c. (Cr., Da.); ditto, s. (A., N.); ditto, Tatton Park, and Dunham Park (*E.L.*)

485. **H. marginaria,** Bkh. = **progemmaria,** Hb. Common everywhere.

485a. „ **var. fuscata,** Harrison. This variety, of unicolorous dark-brown primaries, is common in many parts of Cheshire, particularly in the neighbourhood of Chester (A.); in the neighbourhood of Stockport, where it is reported to be very common by Mr. C. F. Johnson; and in the neighbourhood of Knutsford, where the proportion is about one in ten of the type with all gradations of intermediate forms (Da.) In Delamere Forest the melanism appears to be in course of progress, and to have not yet reached the unicolorous stage. Mr. Prince reports that the type is fast disappearing at Wallasey.

486. **H. defoliaria,** Cl. Somewhat local, but common where it does occur. Most frequently seen in the larva state.

C.—Bidston, Upton, Eastham Wood, Ledsham, and Birkenhead, rather s. (*W.L.*); sp. round Birkenhead (Pr.); Wallasey (*E.L.*); Ince Marshes, f.c. (N.); Chester, very variable and c. at gas lamps, o. at e.l. (A., Do.); White Hall, near Tarporley (Stk.); Delamere, v.c. (H., M., Cr.); ditto, l. often a pest (N.); ditto, Tatton Park, and Dunham Park (*E.L.*, Da.)

F.—Overton and Cwm, c., Rhyl, o. (Pe.)

ANISOPTERYX, Stph.

487. **A. æscularia,** Schiff. Generally common.

C.—Wirral (*W.L.*); Birkenhead Park, n.v.c. (Pr.); Eastham Wood, c. (W.G.); ditto and Hooton (Sh.);

Chester (*W.L.*); rather c. at e.l. Chester and in surrounding district (Do., A.); White Hall, near Tarporley (Stk.); Delamere, f.c. (N., A., M., Ta., H., Da.); Knutsford, c. (Da.); Bowdon (Tp., Da.); Stockport, c. (J.)

F.—Overton, c. (Pe.)

PHIGALIA, Dup.

488. **P. pedaria,** F. = **pilosaria,** Hb.

C.—Common and generally distributed. At Delamere Forest and Knutsford occurs the variety **monacharia,** Stgr., of a uniform sooty-black, with occasionally an olive tinge. This is a parallel form to the *doubledayaria* variety of *betularia.*

F.—Overton and Cwm, o. (Pe.)

BISTON, Leach. = APOCHEIMA, Hb.

489. **B. hispidaria,** F. Local and found only sparingly.

C.—Recorded from Delamere Forest by most of the collectors in the district; also from Pettypool Park (Co.); White Hall, near Tarporley (Stk.); Knutsford (Da.); and Dunham Park (*E.L.*)

D.—Llanrwst (Bl.)

490. **B. zonaria,** Schiff. Local, but plentiful where it occurs.

C.—Wallasey, c. most years, recorded by most of the collectors in the district; Leasowe (Pr.); ditto, Great Meols, Hoylake, West Kirby, and Burton Marsh (W.G.); Frodsham Marsh (Co.)

F.—Near Prestatyn (W.G.); formerly at Rhyl (W.G.)

Car.—Near Conway (W.G.); sandhills Deganwy, c. (N.)

491. **B. hirtaria,** Cl. Delamere, two ex collection Mrs. Leather (N.) This is a doubtful record.

492. **B. strataria,** Huf. = **prodromaria,** Schiff. Not uncommon in extensive oak woods in Cheshire.

C.—Bidston (*E.L.*); Eastham Wood, bred from pupa (W.G.); ditto and Whitford (*W.L.*); Delamere Forest (*E.L.*, Tp.); ditto, rather s. (N.); ditto, n.c. (A.); ditto, n.u. (Da.); ditto, two in 1900, several in 1895 (H.); White Hall, near Tarporley, a few at rest and at e.l. 1901 (Stk.); Chester, at e.l. (A.); Tatton Park, s. (Da., *E.L.*); Dunham Park (Tp.); ditto, Bowdon, and Alderley, r. (*E.L.*)

F.—Overton, o. (Pe.)

AMPHIDASIS, Tr.

493. **A. betularia,** L., and
493a. „ **var. doubledayaria,** Mill. } Common and generally distributed. Both the type (speckled form) and the black variety, with intermediate forms, have been taken somewhat freely at electric light, Chester, by Messrs. Arkle, Dobie, and Newstead; also at electric light at White Hall, near Tarporley, by Mr. J. Henry Stock, M.P., who states that the **var. doubledayaria** is in the proportion of ten to one of the type. Mr. C. F. Johnson records that the type is very seldom taken at Stockport, though odd ones still occur there. The larvæ vary as much as the perfect insects—some being glaucous-green; others browny-black. Miss Perkins records one larva from Bettws-y-Coed more white than black. Other records are: Colwyn Bay (N.); Conway Valley, types (Bl.); near Conway and Ruthin (W.G.)

HEMEROPHILA, Stph.

494. **H. abruptaria,** Thnb. Rare in Cheshire; not recorded elsewhere in the district.

C.—Upton, Tranmere, Rock Ferry, Ness, s., and near Chester (*W.L.*); Chester, one at e.l. 1899 (Do.); ditto, two at a gas lamp in Curzon Park (A.); Delamere, n.c. (H.); White Hall, near Tarporley, one (Stk.); Alderley district, v.r. (*E.L.*)

BOARMIA, Tr.

495. **B. gemmaria,** Brahm. = **rhomboidaria,** Hb. Common and generally distributed.

496. **B. repandata,** L. Common and generally distributed. Mr. G. F. Porritt states that a pretty pale form is taken at Penmaenmawr.

497. **B. roboraria,** Schiff. Mr. J. Thorpe states "formerly at Dunham Park (near Altrincham, Cheshire); now I think exterminated there."

498. **B. consortaria,** F. One taken at Delamere Forest by Mr. J. Thorpe.

499. **B. lichenaria,** Hufn. Very local and rare.

C.—Frankby, s. (*W.L.*, *E.L.*); Prenton Wood (*W.L.*); Prenton, Hooton, and Spital (*E.L.*); Delamere, one (P.C., N.); Mr. H. B. Prince states "There is good authority for this species from an apple orchard at Prenton, but I never took it; never could locate site."

500. **B. jubata,** Thnb. = **glabraria,** Hb. Only one record.

Car.—Near Beddgelert (B.)

501. **B. crepuscularia,** Hb. = **biundularia,** Esp.

In 1896 and 1897 a great controversy was waged in the Entomological Magazines as to whether the so-called **crepuscularia** and **biundularia** of the old lists were two distinct species, or whether each were only local forms of the same species. The conclusion generally arrived at was that in one there were two broods each season, and in the other a single brood. The prior name of **bistortata,** Goeze, has now been generally adopted for the double-brooded species, and **crepuscularia** (= **biundularia**) for the single-brooded.

It is probable that all the records in this district, under the head of **crepuscularia,** are correctly given in accordance with this nomenclature (**crepuscularia** = **biundularia**), though Major Bland states that both species occur in the Conway Valley. Miss Perkins records **crepuscularia** as common at Bettws-y-Coed, and Mr. W. Gardner at Conway.

501a. „ **ab. defessaria,** Frr. = **delamerensis,** B. White.

Most of the collectors in the district have taken this form commonly at Delamere Forest and district, where the insect varies from a speckly light-grey colour to a dark-soot; but almost invariably there is a distinct lighter waved line just before, and parallel with, the hind margin of the forewings. So far as has been ascertained the species at Delamere is single-brooded, although the perfect insect appears as early as March in some years.

502. **B. consonaria,** Hb. The only record is:

C.—"Upton, near Birkenhead, a single specimen only" (C. S. Gregson in *E.L.*)

503. **B. punctularia,** Hb. Rare and local.

C.—East Cheshire, on the authority of N. Greening (*W.L.*); Pettypool Wood, May 1851 (N. Cooke in *Zoologist*, Vol. X., p. 3517); Delamere and Bramall (*E.L.*)

GNOPHOS, Tr.

504. **G. obscuraria,** Hb. Occurs locally in all the counties. Confined to the vicinity of the coast in Cheshire.

C.—Wallasey, Bidston, Tranmere, and Burton (*W.L.*); Heswall, Thurstaston, Bidston, and Storeton, on heather (W.G.); always s., Flaybricks, Bidston, larva and imago (Pr.); near Prenton (*E.L.*)

F.—Ysceifiog (*W.L.*); The Leet (A.); Llanferris (B.)

D.—Ruthin (W.G.); Llangollen (B.)

Car.—Conway and over higher Carnarvonshire Mountains (W.G.); Sychnant Pass, f.c. at dusk (F.H.W.D.); ditto, on rocks 1902 (Da.); Penmaenmawr, l. and imagines (Ta.); ditto, a. also Menai Bridge, &c., a very dark-slaty form (Po.); Abersoch (Da.); Llandudno (Tp.)

Ang.—Lligwy (Ld. B.)

EMATURGA, Ld.

505. **E. atomaria,** L. Abundant on all the heaths and mosses.

BUPALUS, Leach.

506. **B. piniarius,** L. Abundant in Delamere Forest, and recorded from pine wood in all the counties except Anglesea.

SELIDOSEMA, Hb.

507. **S. ericetaria,** Vill. = **plumaria,** Hb. Very rare; the only records are:

C.—Birkenhead—*Stainton's Manual* (*W.L.*); Bidston, taken by the late A. G. Almond (Pr.); Delamere (F. Bolland—in collection Chester General Museum).

THAMNONOMA, Ld. = HALIA, Dup.

508. **T. wauaria,** L. In gardens where there are currant and gooseberry trees; common and generally distributed.

PHASIANE, H. S.

509. **P. petraria,** Hb. Common locally throughout, wherever the common brake fern (*pteris aquilina*) grows abundantly.

510. **P. clathrata,** L. Very local, and met with only sparingly.

C.—Puddington and Delamere (*W.L.*); White Hall, near Tarporley, one about 1900 (Stk.)

F.—Llyn Helig (*W.L.*)

D.—Colwyn (*W.L.*, N.); Llandulas, sp. (N.); ditto, f.c. (P.C.)

Car.—Near Llysfaen Station (Da.)

Ang.—Bull Bay (N.)

SCODIONA, B.

511. **S. fagaria,** Thnb. = **belgiaria,** Bkh. Local; occasionally taken on some of the heaths.

C.—Bidston, s. (*W.L.*, Pr.); West Kirby (Sh.); Storeton, near Birkenhead (*E.L.*); Delamere Forest, s. (*E.L.*, Th.); ditto, one in 1901 (Cr.); White Hall, near Tarporley, one (Stk.); "Whitegate Heath, o.—three specimens the largest number I ever took in one season" (Co.); Wilmslow (Tp.); Lindow Common, local (*E.L.*)

F.—Loggerheads (*W.L.*); Whixall Moss (Th.)

D.—Llangollen (B.)

Car.—Penmaenmawr, l. 1902 (Ta., J.)

ASPILATES, Tr.

512. **A. gilvaria,** F.

C.—Recorded from West Kirby by Dr. W. E. Sharp, and from Hale by Mr. J. Thorpe.

513. **A. ochrearia,** Rossi. = **citraria,** Hb. Recorded from Delamere by Mrs. Leather in *W.L.*

PERCONIA, Hb. = ASPILATES, Fr.

514. **P. strigillaria,** Hb. Common on heaths throughout the Delamere Forest district; other records are few.

C.—Delamere, c. (J., Ta., M., Da.); ditto, a. in 1900 (Th.); Clarke's Moss, Delamere, sp. (N.); Oakmere and Abbot's Moss, a. (A.); Whitegate Heath (Co., Da.); White Hall, near Tarporley (Stk.); Hale (Tp.); Rudheath and Staley Brushes (*E.L.*)

F.—Whixall Moss 1900 (Th.)

D.—Near Colwyn Bay (N.)

NOLIDÆ.

NOLA, Leach.

515. **N. cucullatella,** L. Not plentiful, except in a few places.

C.—Bidston, "somewhat c. formerly; at present by no means so" (Pr.); Chester, c. (A., N., Do.); Ince, Helsby, and Upton (N.); Knutsford, o., and Dunham Massey (Da.)

F.—Rhyl, c., l. from blackthorn 1900, also Cwm (Pe.)

D.—Colwyn Bay, a few (N.)

516. **N. confusalis,** Herr-Schäff.

C.—Puddington, s. (*W.L.*)

D.—Colwyn (*W.L.*)

CYMBIDÆ.

HYLOPHILA, Hb.

517. **H. prasinana,** L. Widely distributed and not uncommon.

C.—Chester, at e.l. 1900 (Do.); Upton-by-Chester (A.); Delamere, c. (N., A., Tp., J., M., Da.); White Hall, near Tarporley (Stk.); Dunham (Tp.)

F.—Near Rhyl (Pe.)

D.—Colwyn Bay, s. (N.)

Car.—Bettws-y-Coed, l. 1895 (H.); ditto, pupa (Pe.)

ARCTIIDÆ.

ARCTIINÆ.

SPILOSOMA, Stph.

518. **S. mendica,** Cl. Appears to be widely though sparingly distributed. It is very rarely met with.

C.—Tranmere (Brockholes in *E.L.*); about old gardens in Wirral (Gregson in *E.L.*); Delamere, one 1893 (H.); Bucklow Hill, near Altrincham (Chappell in *E.L.*); North-east Cheshire (N.G.)

F.—Overton, o. (Pe.)

D.—Colwyn Bay 1879 (*W.L.*)

Car.—Conway Valley, c. (Bl.)

519. **S. lubricipeda,** L. Very common throughout.

520. **S. menthastri,** Esp. Very common throughout.

PHRAGMATOBIA, Stph.

521. **P. fuliginosa,** L. Recorded throughout the district; generally found in the larval state. Favourite situations are the coasts, mountains, and heaths.

C.—Wallasey, l. f.c., found by most who have collected there; Hoylake (W.G.); Prenton (Sh.); Delamere (P.C.); Atchmere, Delamere, l., c. (A., N.); White Hall, near Tarporley, n.c. (Stk.); Dunham, r. (Tp.); Macclesfield (R. South).

F.—Rhyl (W.G.)

D.—St. Asaph (Pe.); Vale of Clwyd (W.G.); Moel Fammau (A.)

Car.—Penmaenmawr (Da.); Deganwy and Criccieth (W.G.)

Ang.—Larvæ p. (A.)

PARASEMIA, Hb. = NEMEOPHILA, Stp.

522. **P. plantaginis,** L. Rare in Cheshire; widely distributed in Wales, where it appears to be locally common.

C.—Rudheath (J. Chappell in *E.L.*); Wilmslow, n.c. (Tp.); North-east Cheshire (N.G.)

F.—Whixall Moss, l. 1895 (Th.); Loggerheads (*W.L.*)

D.—Colwyn Bay (O. Whittaker); ditto and Minera district, l. (N.); Llangollen (B.)

Car.—Llandudno, c. (N.); Gt. Orme's Head (W.G.); Penmaenmawr, c. on the flat parts at the base of the mountain (Po.)

DIACRISIA, Rbr. = NEMEOPHILA, Stph.

523. **D. sanio,** L. = **russula,** L. Not uncommon in suitable localities.

C.—Delamere (Ta., M., Da.); Atchmere, sp. (N., Sh., A.); Abbot's Moss (Co., Da.); ditto and Oakmere (A.); Carrington, rare now (Tp.)

D.—Colwyn Bay, s. (N.)

Car.—Conway Valley, a., but very local (Bl.); Abersoch (A.)

ARCTIA, Schrk.

524. **A. caja,** L. Common and generally distributed throughout.

525. **A. villica,** L. Recorded from Delamere by Mrs. Leather in *W.L.*; and from Bowdon by J. C. Melvill in *E.L.*; but the occurrence is exceedingly exceptional.

HIPOCRITA, Hb. = EUCHELIA, B.

526. **H. jacobææ,** L. Not generally distributed. Abundant at Wallasey and along the N. Wales coast, and common at Chester; but there are very few records for inland localities. Ince Marshes, very scarce (N.); Malpas (A.)

LITHOSIINÆ.

NUDARIA, Hw.

527. **N. mundana,** L. Local and not often met with.

C.—Eastham Wood and Prenton, near Birkenhead (*E.L.*); Chester, one at e.l. 1900 (Do.); Little Budworth (Stk.); North-east Cheshire (N.G.); Macclesfield (R. South); Goyt's Clough (Da.)

Car.—Conway and Bettws-y-Coed, a. (W.G.); near Sychnant Pass 1902 (Da.); Penmaenmawr, n.u. in the mountain lane (Po.); Penmaenmawr Mountain 1902 (Da.)

CYBOSIA, Hb. = LITHOSIA, F.

528. **C. mesomella,** L. Local and not generally common.

C.—North-east Cheshire (N.G.); Chester, at e.l. 1900 (Do.); Delamere Forest, c. (A., N.); ditto, one in 1899 (H.); ditto, one in 1900 (Th.); White Hall, near Tarporley, at e.l. 1900 (Stk.); Little Budworth, s. (N.)

GNOPHRIA, Stph.

529. **G. rubricollis,** L. Rare.

C.—North-east Cheshire (N.G.)

D.—Bathafarn, near Ruthin 1862 (*W.L.*)

Car.—Bettws-y-Coed, pupæ p. under bark in April 1893 (Pe.)

ŒONISTIS, Hb. = GNOPHRIA, Stph.

530. **O. quadra,** L. Only one record.

C.—Chester, one male at e.l. 26th July, 1900 (Do.)

LITHOSIA, F.

531. **L. griseola,** Hb. Of rare occurrence.

C.—Wallasey and Bidston, s. (Brockholes in *E.L.*); Bidston, only o. (Pr.)

531a. „ **var. flava,** Hw. No recent records.

C.—Lane near Dunham-on-the-Hill (*W.L.*)

532. **L. lurideola,** Zinck. = **complanula,** B. Widely distributed, but not often in any numbers.

C.—Throughout Wirral, s. (Brockholes in *E.L.*); Bidston (Johnson in *E.L.*); Newton-cum-Larton, some years ago (Da.); Bromborough (W.G.); Chester, n.u. at e.l. (Do.); ditto, one in 1899 (A.); Delamere Forest (Mrs. Leather in *W.L.*)

F.—Loggerheads (*W.L.*); Overton, o., and Rhyl, o. (Pe.)

D.—Near Ruthin (W.G.)

Car.—Near Conway (W.G.)

Ang.—Lligwy (Ld. B.)

533. **L. complana,** L. Scarce.

C.—Wallasey and Bidston, s. (*W.L.*); White Hall, near Tarporley, one at e.l. 1900 (Stk.)

D.—Colwyn Bay, s. (N.)

Car.—Aber (P. J. Barraud); Abersoch, two 1894 (Da.)

534. **L. caniola,** Hb. There is a record in *Zoologist*, Vol. XIX., p. 7536: "Cheshire"—Specimen exhibited at meeting of Northern Entomological Society, March 16th, 1861.

ZYGÆNIDÆ.

ZYGÆNINÆ.

ZYGÆNA, F. = ANTHROCERA, Sc.

535. **Z. purpuralis,** Brünnich. = **pilosellæ,** Esp. and **minos,** Fuessl. Recorded from only one locality in the district.

Car.—Abersoch, c. (A., J., Da.)

536. **Z. trifolii,** Esp. Local, and seems to occur very sparingly.

C.—Bidston Marsh (N. Cooke in *E.L.*); The Wyches, near Malpas (*W.L.*); Delamere, local, n.c. (H.); Oakmere (Jos. Chappell in *E.L.*); recorded also from Knutsford by Jos. Chappell in *E.L.*, but it has not been taken there in recent years (Da.)

F.—Bagillt (*W.L.*)

D.—Colwyn Bay (A.)

Car.—Abersoch (A.)

537. **Z. loniceræ,** Schev. Very rare.

C.—Bidston (J. F. Brockholes and N. Cooke in *W.L.*); "recorded from Knutsford by Thos. Harrison—*Intell.*, 1857, I., 123" (*E.L.*), but it has not been taken there in recent years.

F.—Darland, near Overton (N.)

538. **Z. filipendulæ,** L. Occurs locally throughout the district except in East Cheshire, from whence there are no records. Less common in North Wirral than formerly (Pr.) More plentiful along the Welsh Coast.

INO, Leach.

539. **I. statices,** L. Very uncommon and local.

C.—Ince Marshes, one (N.); there are five specimens in the Chester Museum Collection taken by Mrs. Leather at Delamere (N.); recorded in *E.L.* from Knutsford by T. Harrison (*Intell.*, 1857, I., 123), but the species has not been taken there for many years (Da.)

Car.—Capel Curig (B.)

540. **I. geryon,** Hb. Extremely local; recorded from only one locality in the district.

Car.—Gt. Orme's Head, sometimes a. (W.G.)

SESIIDÆ.

TROCHILIUM, Sc.

541. **T. apiformis,** Cl. Very few records in the district; but probably the species only requires to be worked for to be found more commonly.

C.—Oxton, bred from l. in aspens (Sh.); c., Hough Green, Chester, last five years (N.); Upton Nurseries near Chester, and Ince, r. (N.)

F.—Rhyl, one 1891 (Pe.)

542. **T. crabroniformis,** Lewin. = **bembeciformis,** Hüb. The same remarks apply to this species.

C.—North Wirral, c. (*W.L.*); Wallasey and Rock Ferry (W.G.); Bidston, "once in a sallow stem, 3 feet long and 4 inches girth, I counted 17 empty pupa cases *in situ*" (Pr.); Upton Nurseries, near Chester (*W.L.*); Bowdon and Hale (Tp.); Macclesfield (R. South, *Ent.*, Vol. XXVIII., p. 267).

F.—Rhyl, one 1897 (Pe.); marsh-land between Bagillt and Greenfield 1857 (F. Archer in *W.L.*)

D.—Vale of Clwyd (W.G.)

SESIA, F.

543. **S. scoliæformis,** Bk. Has been recorded from only one locality in the district, namely Llangollen; but the insect does not appear to have been taken there in recent years.

D.—Llangollen (N. Cooke in *Zoologist*, Vol. XX. (1862), p. 8249); ditto, l. under bark of rotten birch (A.); in a birchwood near Llangollen (W.G., also Ashworth in *W.L.*)

544. **S. spheciformis,** Gern. = **sphegiformis,** F. Rare and local.

C.—Delamere Forest, one 1901 (N.)

D.—Llangollen Valley (T. S. Ashworth in *Zoologist*, Vol. XIII, 1855).

545. **S. tipuliformis,** Cl. Recorded commonly in localities that have been well worked.

C.—Wirral, not infrequent (W.G.); Oxton (Sh.); Chester (*W.L.*, A., Do.); ditto, l. a. in *ribes* (N.); Vicar's Cross (P.C.); Bunbury and Knutsford (Da.); Bowdon, c. (Tp., N.); Stockport, local but c. (J.)

Car.—Near Conway (W.G.); on coast, l. 1900 (J.)

546. **S. culiciformis,** L. Recorded from the Delamere Forest district only.

C.—Delamere Forest, at rest on birch leaves 1897 (Th.); ditto, pupæ in birch stumps (M., N.); Hartford, one (S. J. Capper in *E.L.*)

547. **S. muscæformis,** View. = **philantiformis,** Lasp. Very local, but generally plentiful where it occurs.

F.—Queen's Ferry, l. only, in thrift by the Dee (A.)

Car.—On coast, c. (J., F. C. Woodforde); Abersoch, c. (Da.)

Ang.—Near Holyhead, p. 1900 (R. Freer, *Ent. Rec.*, Vol. XII., p. 248).

COSSIDÆ.

COSSUS, F.

548. **C. cossus,** L. = **ligniperda,** F. Appears to be generally distributed and fairly plentiful in some places. Mostly seen in larval stage.

C.—Wirral (*E.L.*); Bidston, one at sugar (Pr.); o. as l. about Chester (A.); Lache Lane, Chester, one 1899 (Do.); Cherry Orchard, Chester (N.); Tarvin Sands, n.u. in larval stage (F.); Delamere (*W.L.*); ditto, trees attacked by l., f.c. (H.); White Hall, near

Tarporley, l. (Stk.); Dunham (Tp.); Combermere, l. c. in oak, and Farndon, s. (N.)

F.—Near Holywell, at sugar (*W.L.*)

D.—Vale of Clwyd (W.G.); Colwyn Bay, one (O. Whittaker).

Car.—Pwllheli, one at sugar 1895 (J.)

ZEUZERA, Latr.

549. **Z. pyrina, L. = æsculi, L.** Rarely met with.

C.—Chester, four specimens at e.l. (Do.); ditto (A.); ditto, one (J. Thompson); Eaton Hall, near Chester, larva in imported apple-tree 1901 (N.); White Hall, near Tarporley, one 1901 (Stk.); Bollington, near Altrincham (Mr. Jos. Richardson).

HEPIALIDÆ.

HEPIALUS, F.

550. **H. humuli, L.** Very common throughout the district.

551. **H. sylvina, L. = sylvanus, L.** Widely distributed, but local and not generally plentiful.

C.—Wallasey 1899 (H.); Saughall near Chester, and Beeston (A.); Delamere (J., Da.); White Hall, near Tarporley (Stk.); Bowdon, c. (Tp.); ditto and Knutsford (Da.)

F.—Rhyl, o. (Pe.)

Car.—Near Conway (W.G.); Penmaenwawr (Po.); Aber (P. J. Barraud).

552. **H. fusconebulosa,** De Geer. = **velleda,** Hb. Generally distributed, but not common.

C.—Eastham Wood (*W.L.*); Delamere (N., A., Da.); ditto, f.c. (H.); White Hall, near Tarporley (Stk.); Bowdon (Tp.); Macclesfield (R. South).

F.—Holywell and Loggerheads (*W.L.*)

D.—Colwyn Bay (*W.L.*, N.); Bathafarn, near Ruthin (*W.L.*)

Car.—Near Conway (W.G.); Llanfairfechan (Ta.)

552a. „ **var. gallicus,** Ld. Delamere Forest (S. J. Capper in *E.L.*)

553. **H. lupulina, L.** Common throughout the district; swarming on Puffin Island, Anglesea (N.)

554. **H. hecta, L. = hectus, O.** Recorded as common, but local, from all the counties except Anglesea. Abundant at Stockport (J.), and in the Delamere Forest district (Da.)

PYRALIDÆ.

GALLERIINÆ.

ACHROIA, Hb.

555. **A. grisella,** F.

F.—Holywell (*W.L.*)

APHOMIA, Hb.

556. **A. sociella,** L.

C.—Wallasey, o.; c. at Burton, Puddington, and Ness (*W.L.*); Chester (N.); Delamere (A.)

D.—Colwyn Bay, s. (N.)

CRAMBINÆ.

CRAMBUS, F.

557. **C. inquinatellus,** Schiff.

C.—Sandhills Wirral (N.); Wallasey, Hooton, and the Kennel Wood, near Hartford (*E.L.*); Kennel Wood (Co.)

D.—Colwyn Bay (N.); The Leet, v.c. (A.)

Car.—Llandudno (Po.)

558. **C. geniculeus,** Haw.

C.—Bidston, c. (Pr.); Wallasey sandhills and Christleton, near Chester (*W.L.*); Bowdon, c. (Da.)

D.—Colwyn (*W.L.*)

Car.—Penmaenmawr (Po.); Abersoch, c. (Da.)

559. **C. contaminellus,** Hb.

C.—Dee Marsh, near Puddington, and Denhall, rather s. (*W.L.*)

560. **C. tristellus,** F. Common throughout.

561. **C. selasellus,** Hb.

C.—Dee Marsh, near Puddington (*W.L.*); Delamere (A.); White Hall, near Tarporley (Stk.); Heatley (*E.L.*); North-east Cheshire (N.G.)

562. **C. perlellus,** Scop.

C.—Marshes of Bidston, Bromborough, and Puddington (Brockholes); Bidston, n.v.c. (Pr.); Ince and Delamere (N.); North-east Cheshire (N.G.)

D.—Colwyn Bay, apparently s. (N.)

Car.—Top of pass between Llyn Crafnant and Capel Curig (B.)

563. **C. latistrius,** Haw.

C.—Formerly n.u. on a bank which has since been destroyed, Claughton fir wood. Has been occasionally taken between there and Flaybrick Hill (Brockholes); Wallasey (*E.L.*)

564. **C. margaritellus**, Hb.

C.—Oakmere (*W.L.*); Delamere, v.c. (A., N.); Rudheath, near Knutsford, c. (Da.); North-east Cheshire (N.G.); Wybunbury Moss, a. (F. C. Woodforde).

D.—Colwyn Bay (N.)

565. **C. pinellus**, L.

C.—Near Birkenhead and Delamere Forest (*E.L.*); Delamere (A.); ditto, c. in 1901 (Da.); Rudheath, near Knutsford, c. (Da.); Lindow Common (*E.L.*); North-east Cheshire (N.G.)

D.—Colwyn (*W.L.*)

566. **C. falsellus**, Schiff.

C.—Ness (*W.L.*); moss-covered walls near Hooton (*E.L.*); Chester, generally c. (A.); North-east Cheshire (N.G.)

567. **C. hortuellus**, Hb.

C.—Common and general (A.); c. throughout Wirral (Pr.); New Brighton, Lindow Common, and Cheadle, a. but local (*E.L.*); Delamere (N.); North-east Cheshire (N.G.)

D.—Colwyn Bay (N.)

568. **C. culmellus**, L. Common generally.

569. **C. dumetellus**, Hb.

C.—Wallasey sandhills (*W.L.*)

570. **C. pratellus**, L. Common generally.

571. **C. pascuellus**, L.

C.—Common throughout (Pr.); Bidston Marsh, Claughton fir wood, Ness, and Burton (*W.L.*); Ince Marshes (N.); North-east Cheshire (N.G.); Whitegate Heath (Co.); Rudheath, c. (Da.)

D.—Colwyn Bay, c. (N.)

Car.—Abersoch, c. (Da.)

572. **C. hamellus**, Thunb.

C.—Carrington Moss, rough plantations beyond Eastham, Lindow Common, and Wilmslow (*E.L.*); Rudheath, c. (Da.); North-east Cheshire (N.G.)

EROMENE, Hb.

573. **E. ocellea**, Hw.

C.—Recorded in *E.L.* from Eastham Wood and Cheshire Coast, on the authority of C. S. Gregson (*Ent.* IV., pp. 249, 263).

CHILO, Zk.

574. **C. phragmitellus**, Hb.

C.—Bidston Marsh, s. (*W.L.*); Leasowe, n.u. (Pr.)

SCHŒNOBIINÆ.

SCHŒNOBIUS, Dup.

575. **S. forficellus,** Thunb.

C.—Bidston Marsh and Oxton, s.; commoner at Little Neston and Burton; Chester, by canal, c. (*W.L.*); Wallasey, n.c. (Pr.); Chester, at e.l. (A.); North-east Cheshire (N.G.); most swampy places—especially at Liscard; also on the canal bank between Macclesfield and Marple (*E.L.*)

ANERASTIINÆ.

ANERASTIA, Hb.

576. **A. lotella,** Hb.

C.—Wallasey sandhills (*W.L.*); ditto, c. among grasses (Pr.)

PHYCITINÆ.

HOMŒOSOMA, Curt.

577. **H. nebulella,** Hb.

Ang.—Near Holyhead (R. Freer, *E.M.M.*, Vol. XII., p. 13).

578. **H. nimbella,** Z.

C.—Wallasey sandhills (*W.L.*); ditto, l. on ragwort, c. (Pr.); Flaybrick Hill (*E.L.*)

EPHESTIA, Gn.

579. **E. kuehniella,** Z. (Introduced from Mediterranean Ports). Is an established pest; perhaps less common than when first introduced (N.)

580. **E. elutella,** Hüb.

C.—Wirral, about houses (*W.L.*); on rice, &c., in warehouses, Birkenhead (Pr.); in a farm-building, Thornton-le-Moors, near Chester (Co.); Knutsford (*E.L.*)

PEMPELIA, Hb.

581. **P. subornatella,** Dup.

Ang.—Near Holyhead, v.c. (R. Freer, *E.M.M.*, Vol. XII., p. 13).

582. **P. dilutella,** Hb. = **adornatella,** Tr.

C.—Prenton (C. S. Gregson in *E.L.*)

EUZOPHERA, Z.

583. **E. pinguis,** Hw.

C.—Birkenhead (*Stainton's Manual*); Chester, at e.l., n.c. (A.)

SALEBRIA, Z.

584. **S. betulæ,** Göze.

C.—Delamere (A.)

585. **S. palumbella,** Fab.

C.—Bidston Hill, Haddon Wood, and Ness, s. (*W.L.*)

Ang.—Near Holyhead (R. Freer, *E.M.M.*, Vol. XII., p. 13).

586. **S. fusca,** Hw.

C.—Bidston Hill and Claughton fir wood (*W.L.*); Chester, o. at e.l. (A.); Delamere, c. (A.)

F.—Llyn Helig and Moel Fammau (*W.L.*)

DIORYCTRIA, Z.

587. **D. abietella,** F.

C.—Bidston (W. Johnson in *E.L.*)

PHYCITA, Rag.

588. **P. spissicella,** F.

C.—Chester, at e.l. (A.); Dunham Park (J. Chappell in *E.L.*)

ACROBASIS, Z.

589. **A. zelleri,** Rag. = **tumidella,** Zk.

C.—Chester, at e.l. (A.)

F.—Common in wood north of Pen-y-maes, Holywell (*W.L.*)

590. **A. consociella,** Hb.

C.—A single specimen on a lamp in Clifton Park, Birkenhead (J. F. Brockholes); bred from oak-leaves collected at a rough plantation beyond Hooton (Gregson in *E.L.*)

RHODOPHÆA, Gn.

591. **R. marmorea,** Hw.

Car.—Great Orme's Head (Po.)

CRYPTOBLABES, Z.

592. **C. bistriga,** Hw.

C.—Bidston Park Wood, s.; once near Birkenhead (*W.L.*); Dunham Park (*E.L.*)

ENDOTRICHINÆ.

ENDOTRICHA, Z.

593. **E. flammealis,** Schiff.

Car.—Penmaenmawr (Po.)

PYRALINÆ.

AGLOSSA, Latr.

594. **A. pinguinalis,** L. Common in the neighbourhood of stables (*E.L.*)

595. **A. cuprealis,** Hb.

C.—Chester (A.)

PYRALIS, L.

596. **P. farinalis,** L. Generally abundant in stables.

HERCULIA, Wlk.

597. **H. glaucinalis,** L.

C.—Chester, four or five at e.l. (Do.)

HYDROCAMPINÆ.

NYMPHULA, Schrk.

598. **N. stagnata,** Don. Fairly common.

599. **N. nymphæata,** L. Common everywhere.

600. **N. stratiotata,** L.

C.—Bidston Marsh, Ness, and Chester (*W.L.*); Leasowe, n.c. (Pr.); near Liscard, Delamere, and Dunham Park (*E.L.*); Chester, v.c., also at e.l. (A.); Hale (Tp.)

CATACLYSTA, Hb.

601. **C. lemnata,** L. Common everywhere.

EURRHYPARA, Hb.

602. **E. urticata,** L. Common everywhere.

SCOPARIINÆ.

SCOPARIA, Hw.

603. **S. cembræ,** Hw.

C.—One specimen at Birkenhead, another at Denhall (*W.L.*); Neston and Woodchurch (*E.L.*)

604. **S. ambigualis,** Tr.

C.—Bidston (Pr.); Delamere (A.); Pettypool Park and Abbot's Moss, v.a. (Co.)

Car.—Penmaenmawr, a. (Po.)

605. **S. dubitalis,** Hb.

C.—Ledsham, Puddington, and East Cheshire (*W.L.*); Bidston, f.c. (Pr.); Lymm, on stone-wall going from Church to Lymm Cross (Co.)

606. **S. alpina**, Stt. = **gracilalis**, Stt.

C.—Chester (A.)

607. **S. murana**, Curt.

C.—Wirral and East Cheshire (*W.L.*); Prenton Hill, near Birkenhead; wall of Tatton Park (*E.L.*)

608. **S. truncicolella**, Stt.

C.— Wirral, on Scotch firs; also East Cheshire (*W.L.*); Knutsford, Dunham Park, and Prenton Wood (*E.L.*)

609. **S. cratægella**, Hb.

C.—Fairly distributed (A.); Bowdon and Bucklow Hill (*E.L.*)

610. **S. frequentella**, Stt. = **mercurella**, Stph.

C.—Bidston Hill, Ness, Puddington, and East Cheshire (*W.L.*); Bidston, f.c. (Pr.); Chester, o. at e.l. (A.)

Car.—Penmaenmawr (Po.)

611. **S. angustea**, Stph.

C.—Wirral (*W.L.*); Bidston, f.c. (Pr.); Chester, at e.l. (A.)

612. **S. pallida**, Stph.

C.—Bidston Marsh and East Cheshire (*W.L.*)

PYRAUSTINÆ.

SYLEPTA, Hb.

613. **S. ruralis**, Sc. = **verticalis**, Schiff.

C.—Common (A.); White Hall, near Tarporley (Stk.)

NOMOPHILA, Hb.

614. **N. noctuella**, Schiff. Generally distributed (*W.L.*)

C.—Wallasey, v.c. some years (Pr.); Shotwick Marsh, a. (A.); Delamere, o. (A.); North-east Cheshire (N.G.)

PHLYCTÆNODES, Hb.

615. **P. verticalis**, L.

C.—Chester, c. on nettles (*W.L.*, N.); ditto, at e.l. (A.); Vicar's Cross, v.c. (P.C.); Ince Marshes (N.); among nettles Weaver Valley, near Sutton viaduct (Co.); Delamere, as l. (H.); Wallasey and Marple (*E.L.*)

D.—Colwyn Bay (N.)

616. **P. sticticalis**, L.

C.—Wallasey, s. (*W.L.*)

PIONEA, Gn.

617. **P. pandalis,** Hb.

C.—"Recorded only from Castle Mill by Mr. Chappell" (*E.L.*)

618. **P. ferrugalis,** Hb.

C.—Wallasey, f.c. (Pr.); ditto, Bidston, Rock Ferry, and Ness (*W.L.*); Saughall Massie (*E.L.*)

F.—Loggerheads (*W.L.*)

Car.—Abersoch (Da.)

619. **P. prunalis,** Schiff. Common generally.

620. **P. forficalis,** L. Common (*W.L.*)

C.—Wallasey, c.; l. on horseradish (Pr.); Chester, c.; also at e.l. (A.); Vicar's Cross, near Chester, v.c. (P.C.)

D.—Colwyn Bay and Abergele (N.)

Car.—Llandudno (N.)

621. **P. lutealis,** Hb. Common generally.

622. **P. olivalis,** Schiff. Common generally.

PYRAUSTA, Schrk.

623. **P. terrealis,** Tr.

C.—Puddington, one specimen (*W.L.*)

D.—The Loggerheads (*W.L.*)

624. **P. fuscalis,** Schiff.

C.—Wirral (*W.L.*); Sealand Pond near Chester, f.c. (A.); North-east Cheshire (N.G.)

F.—Bagillt and Loggerheads (*W.L.*)

625. **P. sambucalis,** Schiff.

C.—Wallasey, f.c. (Pr.); Birkenhead and East Cheshire (*W.L.*); Chester (Miss Smith in *W.L.*, N.); ditto, at e.l. (A.); Ince Marshes (N.); Knutsford (Da.); Bowdon (Tp.)

D.—Colwyn Bay (N.)

626. **P. cespitalis,** Schiff.

C.—Wirral (*W.L.*, N.); Wallasey (A.); ditto, n.c. now (Pr.); North-east Cheshire (N.G.)

F.—Loggerheads (*W.L.*); The Leet, c. (A.)

Car.—Conway Marsh, a. (Po.)

627. **P. sanguinalis,** L.

C.—Wallasey sandhills (*W.L.*); ditto, among wild thyme (Co., W.G.); ditto, n.c. now; habitat and food-plant destroyed by golf (Pr.); sandhills Wirral (N.)

F.—Rhyl (*W.L.*)

628. **P. purpuralis,** L.

C.—Wallasey sandhills and Ledsham (*W.L.*); Parkgate, Sutton, Knutsford, and Bollin Valley (*E.L.*); North-east Cheshire (N.G.)

F.—Ysceifiog (*W.L.*)

D.—Colwyn (*W.L.*)

Car.—Conway Mountains (W.G.); Penmaenmawr (Po.); Llyn Crafnant (B.)

628a. „ **var. et ab. ostrinalis,** Hb.

C.—Wirral (*W.L.*); Wallasey sandhills (*E.L.*, A.); Hoylake, n.c. (Pr.); Knutsford (*E.L.*); North-east Cheshire (N.G.)

D.—Colwyn Bay (*W.L.*); ditto and Abergele (N.)

Car.—Llandudno and district (N.); Great Orme's Head (W.G.)

629. **P. cingulata,** L.

C.—Wallasey sandhills (*W.L.*, A.); ditto, local (Co.); ditto, n.c. now (Pr.)

F.—Loggerheads, and Talargoch near Rhyl (*W.L.*); The Leet (A.)

D.—Bryn Eurin near Llandrillo-yn-Rhos (*W.L.*); Colwyn Bay (N.)

Car.—Gloddaeth, Llandudno (N.); Abersoch (A.)

Ang.—Near Holyhead 1900 (R. Freer, *E.M.M.*, Vol. XII., p. 13).

630. **P. funebris,** Ström. = **octomaculata,** L.

D.—Llanrwst, c. (D. H. Pearson).

Car.—Dolwyddelan (O. Whittaker).

PTEROPHORIDÆ.

OXYPTILUS, Z.

631. **O. hieracii,** Z.

C.—"Recorded only from Bidston, near Birkenhead, by J. F. Brockholes" (*E.L.*)

632. **O. teucrii,** Greening.

C.—Delamere (*E.L.*)

PLATYPTILIA, Hb.

633. **P. ochrodactyla,** Hb.

C.—Bromborough Pool and Wirral (*E.L.*); Chester (N.); Holford (Da.)

Ang.—Near Holyhead (R. Freer, *E.M.M.*, Vol. XII., p. 13).

634. **P. gonodactyla**, Schiff.

C.—Wallasey, amongst coltsfoot (Pr.); Chester, canal banks, one at e.l., Dickson's Nurseries near Chester (A.); Knutsford and Holford Moss (Da.)

Car.—Penmaenmawr (Po.)

635. **P. cosmodactyla**, Hb.

C.—Bidston, Tranmere, and Claughton (*E.L.*)

ALUCITA, Wlsghm.

636. **A. pentadactyla**, L.

C.—Wallasey, Tranmere, and Liscard (*E.L.*); Noctorum, c. on *convolvulus* (Pr.); Chester, the commonest of the genus; also at e.l.; l. on bindweed (A.); ditto and Ince Marshes, c. (N.); Vicar's Cross, near Chester, c. (P.C.); Delamere 1900 (H.); Great Budworth, l. 1902 (Miss Roscoe); Bowdon (Tp.)

D.—Colwyn Bay (N.)

MARASMARCHA, Meyr.

637. **M. phæodactyla**, Hb.

D.—The Leet (A.)

PTEROPHORUS, Geoffr.

638. **P. lithodactylus**, Tr.

C.—Woodbank Marsh, Shotwick, a.; also Sealand, near Chester, not so c. (A.)

D.—Llanferres (N.G.)

Car.—In profusion on the sandhills near Llandudno (Po.)

639. **P. monodactylus**, L.

C.—Wirral (*E.L.*); Wallasey (Da.); Prenton, among *convolvulus* (Pr.)

Car.—Equally a. as l. and pupæ among *convolvulus* at Penmaenmawr (Po.)

640. **P. tephradactylus**, Hb.

Car.—Bangor (B. Kendrick in *Zool.*, Vol. XXI. (1863), p. 8469).

641. **P. osteodactylus**, Z.

C.—Chester, one (A.)

D.—The Leet (A.); Llanferres (N.G.)

STENOPTILIA, Hb.

642. **S. zophodactyla**, Dup.

C.—Occasional (A.)

643. **S. bipunctidactyla,** Hw.

C.—Wallasey, somewhat c. (Pr.); ditto, New Brighton and Knutsford (*E.L.*); Sealand, near Chester, a. by hedge-rows (A.)

644. **S. pneumonanthes,** Schleich. = **plagiodactylus,** Snell.

C.—Occasionally met (A.); Knutsford (*E.L.*)

645. **S. pterodactyla,** L.

C.—Wallasey, among thyme (Pr.); ditto and Dunham Park (*E.L.*); Sealand, near Chester, o. (A.)

ORNEODIDÆ.

ORNEODES, Latr.

646. **O. hexadactyla,** L.

C.—Noctorum, n.u. (Pr.); Wirral, Eastham Wood, Delamere Forest, Knutsford, Mobberley, and Bowdon (*E.L.*); Bowdon (Tp.); Ince Marshes, s., and Chester (N.); ditto, o., and Backford, n.c. (A.); Delamere, several in 1898 (H.); near Abbot's Moss, c. 1901 (Da.)

D.—Colwyn Bay (N.); Segrwyd, near Nant Glyn (B).

Car.—Abersoch, a, (Da.)

TORTRICIDÆ.

TORTRICINÆ.

ACALLA, Meyr.

647. **A. hastiana,** L.

C.—Throughout Wirral (*E.L.*); Wallasey, f.c. among sallows (Pr.)

648. **A. mixtana,** Hb.

C.—Bidston Hill and Delamere Forest (*E.L.*); Delamere (A.)

649. **A. logiana,** Schiff.

C.—Eastham and Rock Ferry (*E.L.*); Delamere (A.)

650. **A. permutana,** Dup.

C.—Wallasey, f.c. amomg roses (Pr., Co.); "the Wallasey sandhills, where it occurs commonly in some seasons among *Rosa spinosissima,* remain almost the only British locality for this handsome species" (*E.L.*)

651. **A. variegana,** Schiff.

C.—Wallasey, c. among roses (Pr.); Delamere (A.); Macclesfield (R. South).

652. **A. literana,** L.

C.—Wirral, o., and Dunham Park (*E.L.*)

653. A. **sponsana**, F.

C.—Wirral, c., Dunham Park, Cheadle, c., and Alderley (*E.L.*); Delamere (A.)

654. A. **schalleriana**, L.

C.—Flaybricks, near Birkenhead, f.c. (Pr.); Wirral, about Prenton, and Staley Brushes (*E.L.*); Saughall Lane, near Chester (A.)

654a. „ **var. comparana**, Hb.

C.—Wirral (*E.L.*); Delamere (A.)

655. A. **comariana**, Zell.

C.—Delamere (A.)

656. A. **aspersana**, Hb.

C.—Wallasey, c. (Pr.); ditto and New Brighton (*E.L.*); Delamere (A.)

657. A. **ferrugana**, Tr.

C.—Bidston, c. (Pr.); Eastham, c. Wirral (*E.L.*); Delamere (A.)

658. A. **caledoniana**, Stph.

C.—Staley Brushes (*E.L.*)

AMPHISA, Curt.

659. A. **gerningana**, Schiff.

C.—Bidston Hill, a., Oxton Heath, Lindow Common, and Staley Brushes (*E.L.*)

660. A. **prodromana**, Hb.

C.—Storeton and Staley Brushes (*E.L.*)

CACŒCIA, Hb.

661. C. **podana**, Scop.

C.—Generally c.; also at e.l. Chester—with the black form (A); Stretton Moss (Co.)

662. C. **xylosteana**, L.

C.—Delamere (A.); Pettypool and Stretton Moss, c. (Co.)

663. C. **rosana**, L.

C.—Common (Co.); Bidston, c. (Pr.); Delamere (A.)

664. C. **sorbiana**, Hb.

C.—Chester and Ince (N.); Delamere (A.); Abbot's Moss Wood (Co.)

D.—Colwyn Bay (N.)

665. **C. costana**, F.

C.—Formerly c. on Bidston Marsh; Burton Marsh (J. F. Brockholes); Leasowe, n.c. (Pr.); Walton, along bank of River Mersey (Co.)

666. **C. unifasciana**, Dup.

C.—Delamere (A.)

PANDEMIS, Hb.

667. **P. corylana**, F.

C.—Bidston, c. (Pr.); sometimes injurious to fir trees, Chester (N.); Delamere (A.); Bromborough Woods, Dunham Park, Bowdon, and Cheadle Hulme (*E.L.*)

D.—Colwyn Bay (N.)

668. **P. ribeana**, Hb.

C.—Common (Co.); Bidston, c. (Pr.); Ince (N.); Chester, at e.l., and Delamere (A.)

D.—Colwyn Bay (N.)

669. **P. heparana**, Schiff.

C.—Common (Co.); Delamere (A.)

EULIA, Hb.

670. **E. ministrana**, L.

C.—Delamere (A.)

TORTRIX, Meyr.

671. **T. viridana**, L. Abundant everywhere on oaks.

672. **T. forsterana**, F.

C.—Bidston, c. on ivy (Pr.); Chester and Ince Marshes (N.); Delamere (A.)

D.—Colwyn Bay (N.)

673. **T. viburniana**, F.

C.—Delamere (A.); Stretton Moss (Co.); a., but local on the Cheshire moors; Stockport, s. (*E.L.*)

674. **T. paleana**, Hb. = **palleana**, Tr.

C.—Wirral, Wallasey, Bramall, very local, and Knutsford (*E.L.*); Walton, on railway bank (Co.)

674a. „ **var. icterana**, Froel.

C.—Delamere, l. in webs on birch, c. (A.)

INDEX TO NAMES OF SPECIES.

The names in italics are synonyms.

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