

During the passage of the flight through Harpenden the butterflies were seen on a number of occasions to be attacked by birds, and particularly by sparrows and flycatchers. A small area of the Common just in front of the Laboratories was particularly favoured in this respect and several hundred wings were found on the ground, most frequently in groups of four just as they had been bitten off and dropped by the attacking enemy. One collection of them was sent to Prof. Carpenter at Oxford. The following is a summary of the front wings.

	Female		Male	
	Left front	Right front	Left front	Right front
Sent to Oxford	35	39	15	15
Examined at Harpenden .	117	121	44	39

It will be seen that there are remains of nearly three times as many females as males. Prof. Carpenter (1940) reported that 16 of the left fore-wings and 17 of the right had definite beak marks, which according to Collenette's figures (1935, *Proc. zool. Soc. Lond.* 1935 (2), pl. 1) suggested attacks by Pheasant, Robin, House Sparrow, Starling, Spotted Flycatcher, Great Tit or Blue Tit, and Yellow Hammer or Meadow Pipit or Chiffchaff. There were also many beak marks on the wings retained for examination at Harpenden.

Records outside Harpenden.

Table 24 gives a summary of over one hundred records received of directional flight in other parts of the country, and these, together with some of unusual abundance, are shown on the map in fig. 29.

In England there appear to have been two main movements. The first was to the south through Cambridge, Hertfordshire, Oxford, Shropshire, Gloucester, Somerset and South Wales, occasionally reaching almost to the south coast. The second was a large immigration from the south or south-east all along the south coast from North Foreland in Kent through Eastbourne, Hastings, the Isle of Wight, Bournemouth, Poole, Bridport and South Devon.

In addition to these there were some eastward movements observed in south-east Scotland; one observation of a southerly movement of a very large swarm in Yorkshire; some movements in various directions in Central Wales; and two records of large numbers coming in from the sea on the north Cornwall coast; possibly these latter had come from South Wales.

The butterflies were recorded in unusual numbers all over the country from Fair Isle off the north of Scotland to all parts of England, and in the south of Ireland.

The large numbers of observations round London, shown in the table and on the map, and on the Sussex coast, do not necessarily indicate greater abundance of butterflies, but a greater number of observers and more interest. Many of the London records were obtained through a B.B.C. radio announcement assisted by notices in some newspapers.

TABLE 24.

Records of directional flights of *P. brassicae* in the British Isles in 1940.

May 18	Morecambe, Lancs	S.E.	Many hundreds	H. W. Slater
May 21	Hilbre Is., Cheshire	E.N.E.	Thousands	Blackler (1940)
May 26	Catcleugh, Northumberland	S.W.	Very common	R. Craigs
July 14	Nr. St. Albans, Herts	S.W.	Hundreds	N. L. Birkett (1941)
July 14	Abergavenny, Mon.	S.W. and S.	3-4 per min.	J. B. G. Tulloch (1941)
July 14	Harpenden, Herts	S.	Many hundreds	J. Henderson-Smith
July 14	Hitchin (Herts) to Cambridge	S.	Thousands	O. G. Butler
July 14	Wheatfen Broad, Norfolk	N.	"Good numbers"	E. A. Ellis
July 14-23	Brighton	N.E.	On 23rd very large flight	H. Blackiston
July 15-Aug. 7	Harpenden, Herts	S.	Continuous flight	C. B. Williams (see p. 195)
July 15	Southwick, Sussex	—	Snowstorm	B. Storrell
July 15-30	Norwich district, Norfolk	N.	—	E. A. Ellis
July 15	Slough, Bucks	Mostly W.	Hundreds	B. A. Cooper
July 16	Shipwash Lightship, off Harwich, Essex	E.	Dozens	O. L. R. Torner
July 17	Fairlight, E. Sussex	N.	Very common	—, Shearer
July 17	Hastings, Sussex	N.E.	Very common	A. Belt
July 17	Eastbourne, Sussex	N.E.	Many hundreds	S. J. T. Jose
July 17	Bexhill, Sussex	E.N.E.	Thousands	O. H. J. Sargent
July 17	Crowhurst, E. Sussex	N.	Swarms	C. B. Sharpe
July 17	Hastings, Sussex	E.N.E.	Hundreds	T. Dannreuther and D. Brightmore
July 18-22	Eastbourne, Sussex	W. on 19th	Hundreds	C. H. Hutchinson
July 18	Bexhill, Sussex	From sea	—	H. D. Peile
July 18-25	Portsmouth, Hants	S.	Considerable flight	Lt.-Col. Baker
July 19	Guestling, Sussex	N.	Large numbers	Mrs. Addison
July 19	Bexhill, Sussex	Up the Valley	"Millions"	Reported to H. D. Peile
July 19	Herne Bay, N. Kent	From the sea	Swarm	M. Greenfield
July 20-27	Bexhill, Sussex	E.	Thousands	H. J. North
July 20-Aug. 6	Tring, Herts	S.E.	"Influx"	A. H. Bishop
July 21-27	Newbury, Berks	S.	Large numbers	A. S. Williams
July 21	Shipwash Lightship, off Harwich, Essex	W.	Dozens	O. L. R. Torner
July 22	Shipwash Lightship, off Harwich, Essex	E.	Dozens	O. L. R. Torner
July 22-23	Farnborough, Berks	S.W.	Thousands	W. Groves
July 22-23	North Foreland Lighthouse, Kent	N.W.	Hundreds	H. W. Bowling
July 22	Ruislip, Middlesex	E.	Hundreds	P. A. Buxton
July 22-25	Burgess Hill, Sussex	S.	Large numbers	F. Balfour-Browne
July 23	Oxford	S.	Large numbers	G. D. H. Carpenter
July 23	St. Albans, Herts	S.	Thin flight	D. Brightmore
July 23-25, and Aug. 1	Aberystwyth, Cardigan.	W.	Thin movement	J. R. W. Jenkins
July 24-29	Nr. Boscastle, N. Cornwall	E.	Passing for 5 days	S. E. Clark
July 24	Builth, Brecknock	N.W.	Up Wye Valley	J. R. W. Jenkins
July 24-25	Walcot on Sea, Norfolk	S.	Several	K. Love
July 25 and 29	Harrow, Middlesex	W.	Very large numbers	E. Stone
July 25	Eastbourne, Sussex	From the sea	Hundreds	E. O. Arnold
July 25	Hastings, Sussex	Most S.E.	Very common	T. Dannreuther
July 25	Bexhill, Sussex	E.	Scores	H. D. Peile
July 25 and 26	Eastbourne, Sussex	E. and E.N.E.	Thousands	G. J. T. Jose
July 25-29	Brighton, Sussex	N.	Thousands	H. Blackiston
July, end	Hastings, Sussex	E.	Very common	T. Dannreuther
July, end, to mid-Aug.	Edinburgh	Gen. to E.	Unusual numbers	A. E. Cameron
July, last week	Shaftesbury, Wilts	S.	Millions	O. M. Coventry
July, last week	Watford, Herts	S.	Large numbers	J. E. Allen
July, last week	Highgate, London, N.6	S.	1 per sec. in sight	Mrs. J. B. Priestley
July, end	Bricket Wood, Herts	S.E.	Like snowstorm	N. L. Birkett
July 26	Welling, Kent	W.	Very large numbers	Mrs. Hichmott
July 26-29	Maidenhead, Berks	W.	Steady procession	I. Mees
July 26	Grays, Essex	W.	Hundreds	K. R. Luten
July 26	Bexhill, Sussex	N.	—	H. D. Peile
July 26	Shanklin, I.O.W.	N.N.W.	Many thousands	O. S. Best
July 26	Milford-on-Sea, Hants	—	Sudden swarm	W. Burton
July 26	Eastbourne, Sussex	—	A second immigration	C. H. Hutchinson
July 26	Hastings, Sussex	N.E.	About 100	A. Belt
July 26 and 27	Hastings, Sussex	N.E.	Hundreds	T. Dannreuther
July 27	Crowhurst, Sussex	E.	Thousands	G. W. Seedbury
July 27 and 28	Catford, London, S.E.6	S. or S.E.	Large numbers	H. Fuller
July 27	Worcester Park, Surrey	N.	Hundreds	J. J. Ketchall
July 27	Dolgellay, Merioneth	S.W.	Flying down valley	J. R. W. Jenkins
July 27	Hounslow, Middlesex	S.W.	Hundreds	F. Coulston
July 27	Hastings, Sussex	W.	Massed	A. J. Cruttenden
July 27	Hastings, Sussex	To E.	Flock	G. W. Seedbury
July 27-28	Lydiate, nr. Liverpool	N.E.	Large numbers	J. Clark
July 28-29	Sandhurst, Kent	N.	Unusually abundant	G. V. Bull
July 28	Beachy Head, Sussex	N.	Great numbers	C. H. Hutchinson
July 28	Owlink, Sussex	N.E.	—	O. J. T. Jose
July 28	Hastings, Sussex	E. (most)	Thousands	T. Dannreuther
July 28	Eastbourne, Sussex	N. and E.	Thousands	C. H. Hutchinson
July 29	Shipwash Lightship, off Harwich, Essex	S.E.	Dozens	O. L. R. Torner

TABLE 24 (Continued).

July 29	Canford Cliffs, nr. Poole, Dorset	To N.E.	Groups coming in from sea	J. Heath
July 31	Cardiff, Glamorgan	S.W.	Steady movement	G. F. Cockbill
July 31-Aug. 5	Hove, Sussex	From sea.	Up to 20 at a time	G. Eade
Aug., beginning	N. Somerset and S. Gloucester	N.	Invasion	C. L. Walton
Aug., early	North Wootton, Norfolk	N.	Enormous cloud	N. Tracey
Aug. 1	Bridport, Dorset	N.	Air filled. From the sea	A. Curtis
Aug. 1	Catalough, Northumberland	S.W.	Very common	R. Craigs
Aug. 2	Hastings, Sussex	E.	Common, but only few moving	T. Dannreuther
Aug. 2-6	Hove and Brighton, Sussex	N.	Coming in from sea	E. J. Eade
Aug. 3-4	Newquay, Cornwall	E. or S.E.	Large numbers from the sea	—, Abel
Aug. 3	Newport, Salop	S.E.	Numbers	H. O. F. Newton
Aug. 4	Abergavenny, Mon.	S.S.W.	5-6 per min.	J. B. G. Tulloch (1941)
Aug. 4-11	Torquay, Devon	—	Swarming	B. A. Thorn
Aug. 4	Poole, Dorset	N.	Thousands from sea	A. Bromby
Aug. 4	Horam and Vines Cross, Sussex	N.E.	Thousands	L. R. Eaton
Aug. 5	Dawlish, S. Devon	W. and N.W.	About 200 per hour	D. C. Thomas
Aug. 4	Goathland, Yorks	S.E.	Lake snowstorm	W. S. Medlicote
Aug. 5	Chepstow, Gloucester, Oxford and Thame	S.	Thin steady movement	G. F. Cockbill
Aug. 7	Buntingford, Herts	S.E.	Thousands	D. A. Boyd
Aug. 8-17	St. Albans, Herts	S.S.E.	Thin movement	D. Brightmore
Aug. 10	Bournemouth, Hants	N.W.	1000 per hour	A. Bromby
Aug. 15	Dunblane, S. Perthshire	E. and N.E.	Unusual numbers	A. E. Cameron
Aug. 16	Black Mts., Monmouth	S.S.E.	2-3 per min. 50 yds.	P. A. Buxton
Aug., mid	Lothians, Scotland	? to E.	Snowstorm	Newspaper report
Aug. 25	Cordom Tor, S. Devon	S.E.	Many	C. G. Butler
Aug., end	Newton Abbot, Devon	S.E.	Still obvious	C. G. Butler
Sept. 7	Sparkford, Dorset	S.S.W.	Dozens	C. G. Butler

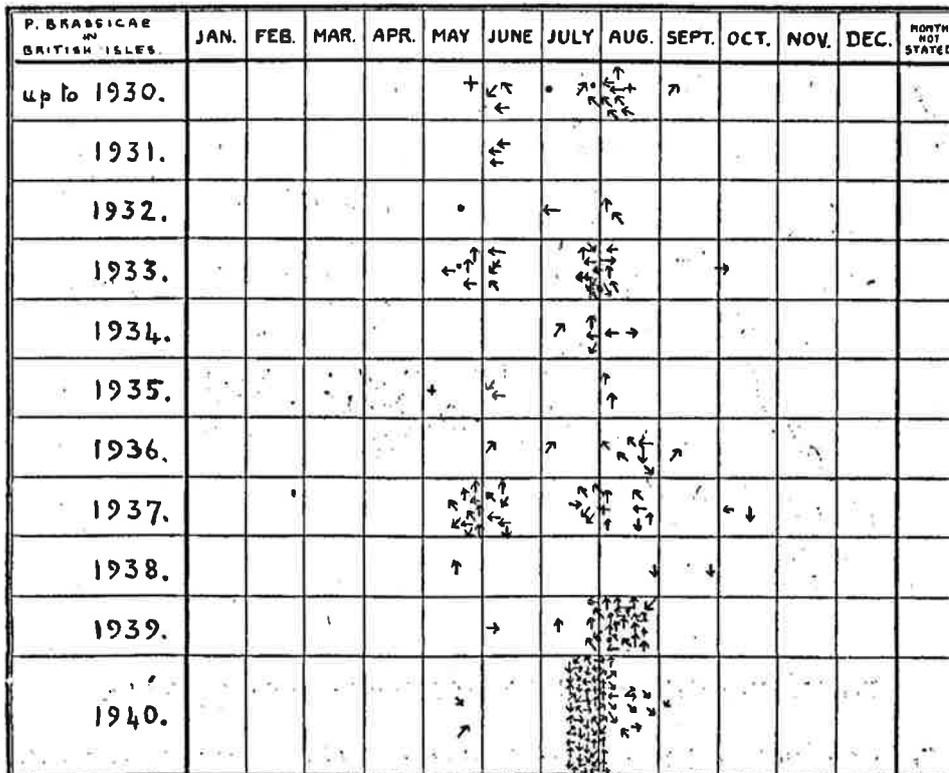
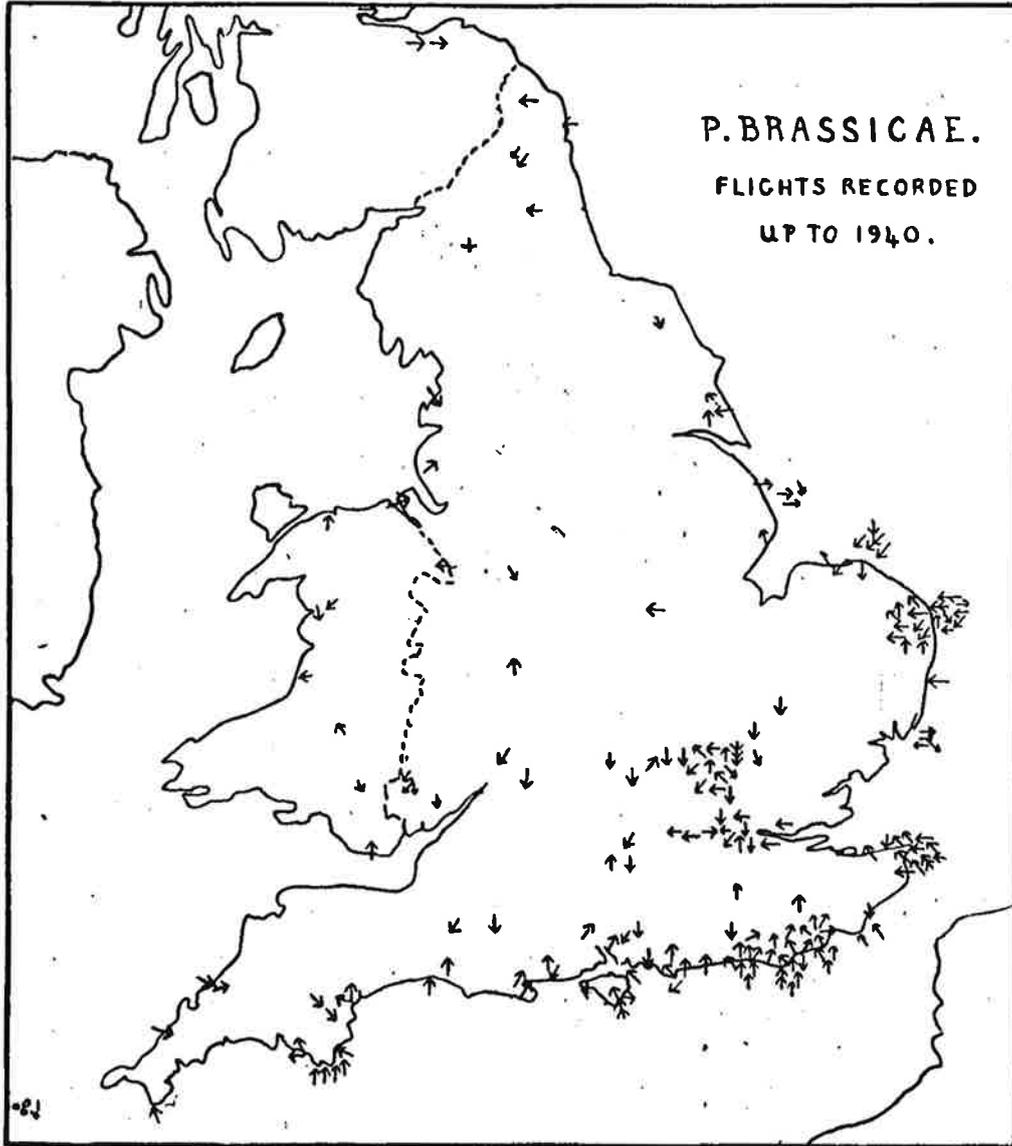


FIG. 30.—Diagram of recorded flights of *P. brassicae* in the British Isles.

General summary of all records.

Finally, fig. 30 and the maps of England and of the Continent in figs. 31 and 32 give a complete summary of over 300 records so far collected of directional flights of *P. brassicae*.



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FIG. 31.—Map of all recorded flights of *P. brassicae* in the British Isles.

From fig. 30 it will be seen firstly that records since 1930 have far outnumbered those relating to earlier years. This is not a biological fact, but is due to greatly increased interest in the problem. Secondly, that the chief migration years in England since 1930 have been 1933, 1937, 1939, and 1940, the latter having by far the most widespread and striking movements. Thirdly,

that the two main seasons for migration to occur in England are (1) the end of May and beginning of June and (2) the end of July and first half of August. These two seasons are also found on the Continent but there (Williams 1939c) the second season is very much more important than the first.

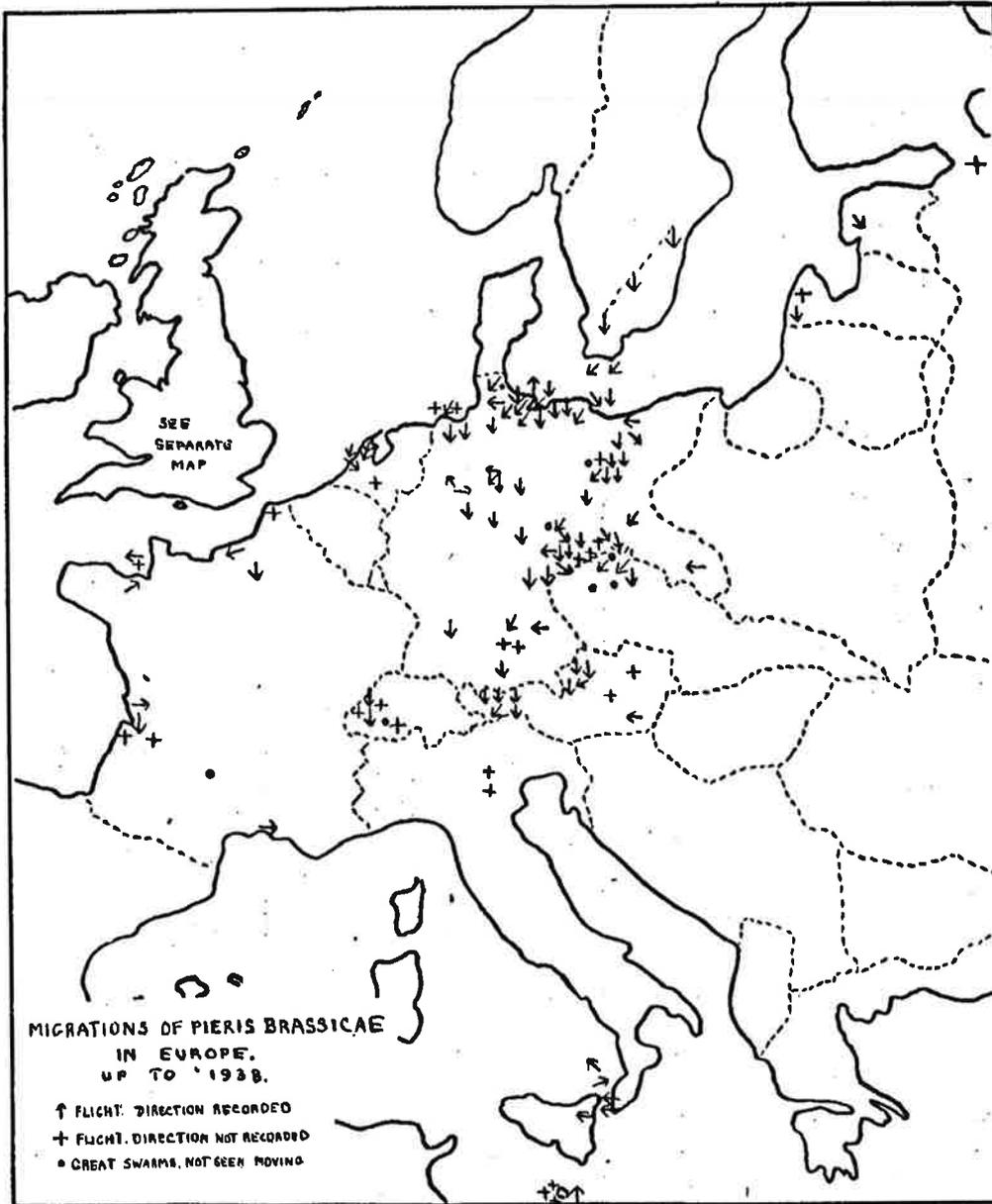


FIG. 32.—Map of all recorded flights of *P. brassicae* in Europe.

Fig. 33 shows a summary of all flight directions for these two seasons in England and on the Continent. In England both seasons give flights preponderating to W. and N.W. On the Continent the first season is rather vague but the second is overwhelmingly to the south.

The map of England (fig. 31) shows the large numbers of records of migrations round the East and South coasts, and also the effect (in increased number of records) of specially interested observers at Harpenden (about 25 miles N. of London) and at Hastings.

The map of the Continent (fig. 32) shows the very definite southward

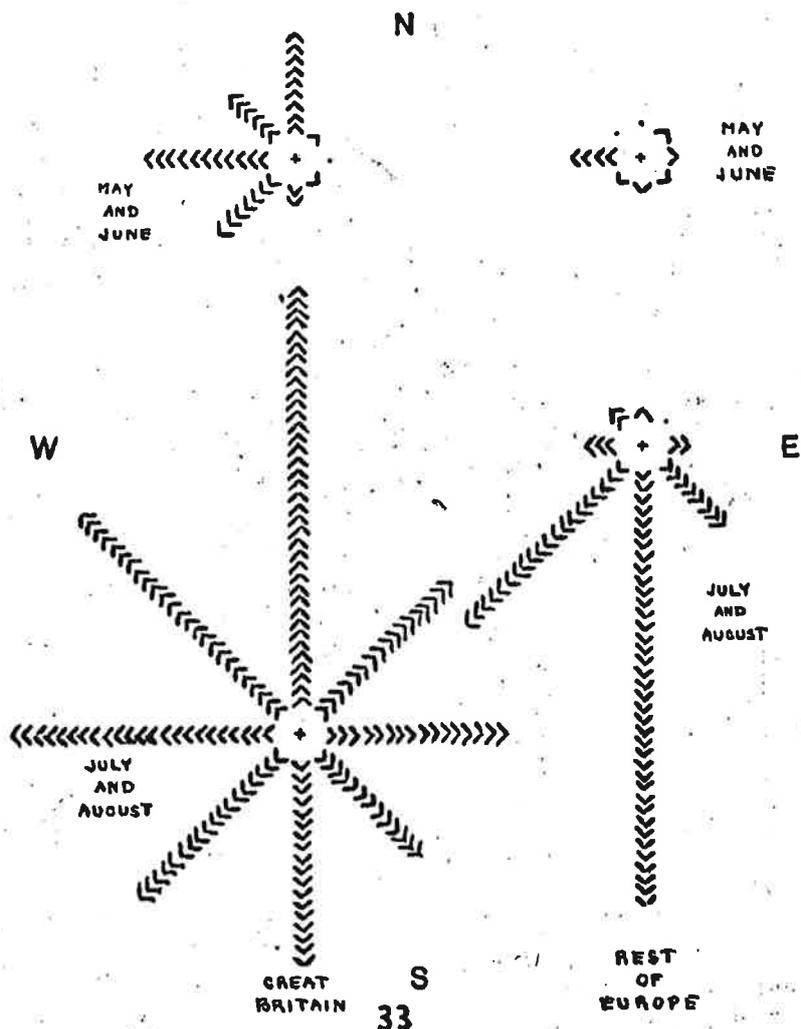


FIG. 33.—Direction of flights of *P. brassicae* in the two flight seasons in Great Britain and on the Continent.

movement which appears to start in Scandinavia, passes south, particularly through East Germany, and the Tyrol, and apparently breaks up against the mass of the Alps.

There are also a few records in the Mediterranean, discussed more fully in Williams 1939a, that do not as yet fit in with any scheme.

(5) *Vanessa cardui*.

Since my previous review of the species (Williams 1930b: 168-212) the following records have been received for the European area:—

- 1918, May 11. Lustenau, Vorarlberg, Germany. To N.
Many in early afternoon; by 4-6 p.m. very abundant; hundreds seen in an hour, flying very fast. Hammerle (Seitz 1918).
- 1918, May 17. Oberturkheim, Neckartal, Germany. To N.W.
Many flying 2-4 p.m.; very thick on left bank of Neckar River; flying singly but always 4-5 in sight: fresh condition; flying very fast. Karlgraf (Seitz 1918).
- 1928, May-June. Scilly Islands.
First seen 31st May, increased to swarm on 3rd June. Frohawk (*Entomologist* 61 : 172).
1928, end May and June. British Isles.
Great numbers appeared in Kent. Theobald (*Entomologist* 61 : 234). Swarming at Margate on 8th June. Higgins (*loc. cit.* : 952). In extreme abundance at Torquay on 15th June. Morgan (*loc. cit.* : 182). Larvae common at Aberdeen on 17th June.
- 1928, Aug. and Sept. England.
Numerous records of abundance.
- 1928, Autumn. Skama, Sweden.
Common (Wahlgren, E., 1928a).
- 1929, May 28. Hastings, England. To N.E.
Dozens seen flying from 2-5 p.m. on hot day after cold wet spell. Steady rapid flight to N.E. (J. Jones mss.).
1930. England.
Only very few records and several notes on rarity.
- 1931, May 3. Cavalaire, Var, France. To N.
Very many in groups of 1-7 close to ground, after violent storm from the S.E. (Eliot mss.).
- 1931, May 24. Schwab-Hall, Württemberg, Germany. To N.E.
Flying 5-6 p.m. every half-minute, always 2-3 in sight, about 200 altogether, flying with the wind (Renner 1931).
- 1931, May 24. Flims, Graubünden, Switzerland. To N.W.
From morning to evening in quick flight. Corti (Warnecke 1931).
- 1931, May. Leysim, Switzerland. To N.E.
Flying in numbers. Dr. G. Marburg and P. Eschwege (Warnecke 1931).
- 1931, May 25. Zurich, Switzerland. To N.E. (by compass).
Flying along railway track, one per minute, out of sight of each other. Temperature 30° C. (Fischer 1937).
- 1931, May end. Ozoir la Ferrière, nr. Paris, France. ? To N.
Flight seen by R. Oberthur (Mezger 1932).
- 1931, May end. England.
Arrived in great numbers on Sussex coast on 27th (*Ent. Rec.* 43 : 111). Invasion of great numbers in Devon on 29th May (*Ent. mon. Mag.* 67 : 160).
- 1931, June 3. Ozoir la Ferrière, nr. Paris, France. To N.
A hundred passed singly very fast (Mezger 1932).
- 1931, June 4. Sark, Channel Island. ? To N.
Numbers coming in from the sea with *P. brassicae* from French coast. Newman (*Ent. Rec.* 43 : 185).
- 1931, July 12. Edinburgh, Scotland.
One seen (C.B.W.).
- 1931, July 5. Bardon Hill, Leicester, England. ? To S.W. by W.
Hundreds in migratory flight on warm sunny afternoon (D. P. Lewis mss.).
- 1931, July 23. St. Leonhard, Pitztal, Tyrol. To S.
Thousands flying singly on Blockkogel (3098 m.) from 11 to 12 a.m. in spite of low air temperature. Again seen 1-2 p.m. (Bergmann 1931).
- 1931, July-Aug. St. Kilda, Outer Hebrides, Scotland.
Seen almost every day from 24th July to 10th August. Lack (*Ent. mon. Mag.* 68 : 143).
- 1931, end July. Stockholm, Sweden.
Three females captured. Richter (Seitz 1931).
- 1931, Aug. Iceland.
One captured at Flateg, Breidafjordur, and four at Skjaldvarafoss. M. Bjornson (Reykjavik N.H. Mus.).
- 1931, Aug. 3. Belvedere, nr. Champex, Switzerland. To S.S.E.
Flying continuously in groups of 5-6 from 11 to 12 a.m., a few feet below the Belvedere Ridge on west side at altitude of about 5500 feet. Clear sunny day. Thackeray (Williams 1933b).
- 1931, Aug. 4 and 5. Near Bludenz in Vorarlberg, Austria. To S.
Many hundreds flying to south, seen for many hours on the 4th and from 8 a.m. on the 5th. Also seen on Mondspitz 2000 metres high (Lenz 1931).

- 1931, Aug. 20. Val d'Arpette, Switzerland. To W. of S.
One or two per minute on 100-yard front across top of valley. Thackeray (Williams 1933b).
- 1932, May 21. Bohnabreena, Co. Dublin, Ireland. To N.W.
About 8 passing 3-4 p.m. in steady rapid flight, wind light N.W. (C. C. Ellison mss.).
- 1932, May 25 and 26. North Foreland, Kent. To W. and N.W.
Small number passing, wind N.-N.E. (Bowling mss.).
- 1932, June end. Balancourt, nr. Corbeil, Seine et Oise, France. To N.N.E.
Flight of many thousands, 10 a.m. to 1.30 p.m., flying at level of the tree tops in belt not more than 15 feet wide. Fine, no wind. Gastineau (Williams 1939d).
- 1932, Aug. 9. Winchelsea, Sussex. To W.
Small number, very fast and lively (Tomlin mss.).
- 1932, end Sept. Arosa, Switzerland. To S.
Flight observed coming over the "Obersee" for many hours without change of flight line. Fischer (1937: 67).
- 1932, Sept. or Oct. Iceland.
One captured at Faqurholmsmyri in S.E. of Iceland and now in collection of Reykjavik Museum. (G. Gigja in letter to T. Dannreuther.)
- 1933, May 19. Start Point, Devon. To W.
About 9 seen coming in from the sea about 3 p.m., calm. Temperature about 58° F. (Godfrey mss.).
- 1933, May 28 and 29. Start Point, Devon. To N.
Small numbers seen. Wind E. and S.W. (Godfrey mss.).
- 1933, June 1-27. Start Point, Devon. To N., N.W. or W.
Every day twenty to thirty seen in rapid flight inland (Godfrey mss.).
- 1933, July to Sept. Reykjavik, Iceland.
Several seen on 19th July; very common on 8th and 9th August; ten seen on 9th September. G. Gigja. Two in collection of Reykjavik Museum.
- 1933, Oct. St. Marys, Scilly Islands. To S.
During first fortnight hundreds of *cardui* and *atalanta* about, chiefly going south, all gone about 16th (R. Trotter mss.).
- 1934, beginning of Aug. Swanage, Dorset. To W.
Steady flight across sea from Isle of Wight towards Swanage (Jobling mss.).
- 1935, March 9. Lydda, Palestine. To N.
Thousands seen at 11 a.m. Wind light S.W. Dallmeyer (27.xii.1935, *Times*).
- 1935, March, end. Cyprus. To W.
Large number seen flying to W. at Nicosia. Damage by larvae in April and May. Not seen and no damage later in year. Morris (*Ann. Rept. Dept. Agr. Cyprus* 1935).
- 1936, June 19. Scilly Islands. To N.
About 20 seen. Wind light S.E. (Trotter mss.).
- 1936, June 21-26. Isle of Wight. To W. and N.W.
About 200 seen passing. Rapid flight on 21st and 26th (Buckstone mss.).
- 1936, Oct. 1-10. St. Marys, Scilly Islands. To S.E.
Scores passing, wind E. and S.E. (R. Trotter mss.).
- 1937, May 29. Near Rye, E. Sussex, England. To N.
Steady trickle of ones and twos coming inland from the sea from 4.30 to 8 p.m. Fine and warm. Wind light N.E. (Ticehurst mss.).
- 1937, June 11. Round Island, Scilly Islands. To N.N.E.
Dozens passing 1-6 p.m. Sunny, wind light S. (Trotter mss.).
- 1937, Aug. 1-7. Nr. Hastings, Sussex. To N.N.W.
About one hundred seen coming in from the sea about 3 feet above the water. Sunny and warm, no wind (Eves mss.).
- 1939, May 28. Ionian Sea, Mediterranean. To S.E.
Migration observed in lat. 36° 40' N., long. 18° 22' E., about 150 miles S.E. of Italy (H.M. Naval Vessel report).
- 1939, May 18-June 19. Cavalaire, Var, France. To N., N.E. and N.W.
Seen passing almost every day (N. Eliot 1939, mss.).
- 1939, May 31. Nr. Dartmouth, Devon. To N.
About forty seen coming in from sea flying high and not stopping (Brown mss.).
- 1939, June 7. St. Marys, Scilly Islands. To N.W.
Dozens passing, bright warm day. Wind N.E. (R. Trotter mss.).
- 1939, June 7. Riehen, nr. Basle, Switzerland. To E.
Migration from 11 a.m. to 4 p.m., like a snowstorm in p.m. (newspaper report).

- 1939, June 8. Rennes, W. France. To N.
 Many hundreds passed noon to 3 p.m. Weather stormy with occasional sun, warm, wind moderate west (R. Oberthur mss.).
- 1939, June 8. Chiemsee, nr. Munich. To N.E.
 Migration according to newspaper report.
- 1939, June 5-12. Garonne and Dordogne, France.
 Extraordinary passage, literally all over the place. Sabastian (Muspratt *in litt.*).
- 1939, June 19. Savoie, France. To N.W. and N.E.
 Thin migration, 3 per minute on 50-yard front at junction of Isère and Arc Rivers. Mostly to N.W. with about 8% up a valley to N.E. (Eliot, 1939 and mss.).
- 1939, July. N.W. France.
 Very heavy damage by caterpillars to artichoke, in Brest-Finistère district (newspaper report and letter from M. Cusson).

It will be seen that the recent years of unusual abundance were 1928, 1931, 1937 and 1939. In 1930, 1934, 1935 and 1938, on the contrary, there were very few records. Estimates of the numbers recorded each year for 1928-1931 will be found in Table 4, and a discussion of the earlier history on p. 114.

It is interesting to note that in the above list there are only three records of flight in September and October and they are all in a southerly direction as follows:—(1) 1932, end Sept., Switzerland to S.; (2) 1933, begin. Oct., Scilly Islands to S.; (3) 1936, begin. Oct., Scilly Islands to S.

The problem of the return flight is dealt with on p. 242.

V. cardui in the Atlantic and in West Africa.

A number of records are now available for the occurrence of *V. cardui* in West Africa and at sea off the West African coast. The following is a summary of the evidence.

At Sea.

1858, May 28. Off Teneriffe.

One captured 90 miles west of Teneriffe. Trimen (1873, *J. Linn. Soc.* 11 : 276).

1866, Sept. 16. Off Cape Verde Islands.

Many seen about 200 m. from Cape Verde Islands and about 600 miles from Gambia. Herbert (1867, *Entomologist* 3 : 266).

(? 1891.) Off N.W. Coast of Africa.

Many thousands fell exhausted on deck of sailing vessel several hundred miles from shore, for nearly 24 hours. Buckstone (1926, *Entomologist* 59 : 171).

1904, end Sept. or early Oct. Off Cape Verde.

Several seen about 47 miles from land. Manders (1905, *Ent. Rec.* 17 : 235).

1932, Sept. 28. S. of Madeira.

Flight between 11 p.m. and midnight in lat. 17° 47' N. and 17° 35' W.; 87 miles from land. Twelve captured, four males and eight females. D. Kingdom (Poulton 1932b and 1933b and c).

1935, Sept. 28. Between Cape Verde Islands and Coast.

Ship steamed all day through swarm of many hundreds: moderate N.E. trade wind. J. S. Hudson (Riley 1936).

It will be noted that in four of the five records in which the month is given, the period is September or October. The only exception (Trimen 1858) relates only to a single individual.

In Nigeria.

There is also considerable evidence to show that in Nigeria the species becomes suddenly abundant year after year at just the same period. Records are available for 1928-1936.

In 1928 *V. cardui* appeared in the Benue Province towards the end of September and were still abundant at the end of October. At Kafsina Ala on the 27th September there were hundreds and many pairs mating (O. B. Lean).

In 1929 it was seen at Ibadan on 25-27th September and at Ilorin (N. Nigeria) from the 9th to 14th October in some numbers and a few till the end of the month (O. B. Lean). At Arochuku Heslop (1931) reports a small immigration at the same time as in 1930 (*q.v.*).

In 1930 it was first seen at Bende on 1st October and increased rapidly in numbers, always faded and sometimes frayed. By mid-October "almost every patch of intensely hot bare soil on the paths and open hill sides had its *cardui*." It was generally abundant but by the end of October the numbers had begun to decline and by 9th November hardly a specimen was to be seen (Heslop 1931). Heslop considers that there had been "a large migration on the southerly and south-easterly breezes of late September."

According to O. B. Lean, it appeared in this year in Ibadan on 25th September but not in large numbers.

In 1931 Heslop (1932) records the first one seen at Okigwi in S.E. Nigeria on 15th September and by the end of the month it was possible to see a dozen at once. They were also in small numbers at Port Harcourt from 6th to 15th October.

In 1932 the first were observed at Port Harcourt on 29th September (Heslop 1935) and two or three were seen most days during October; the last here was on the 2nd November. A few, however, were seen in the north of the province on the 5th November.

In 1933 Heslop was away during the normal *cardui* season, but on his return he saw one individual at Okigwi in the extreme north of the province on 22nd November (Heslop 1935).

In 1934 a small and battered female was seen at Okigwi on 16th May, a faded male came to light on the evening of the 17th June and another on the following night. The normal arrival was a little later than usual and the first specimen was seen by Heslop (1935) on 4th October at Orlu; they had, however, already been seen at Okigwi on the 16th-22nd September by Lipscomb. They think that the flight originated on the edge of the Sahara desert, which is about 200 miles to the north of Kaduna, and had worked its way south. The last specimen was seen on the 11th November and the species was much rarer than usual.

In 1935 Golding (Williams 1936a) reports that he saw one on 8th July, which was the first that he ever recollected occurring at that time of the year; later four were seen on 30th September, which he says is the normal time of the year. Heslop (1937) reports that in this year he saw no May-June individuals. He was away later in the year but was informed that there was a sparse appearance in October and the early part of November.

In 1936 the September-October flight failed completely and Heslop (1937) saw only one individual near Obetin on the 5th October.

There is no doubt from the above evidence that there is considerable migration activity of *Vanessa cardui* in that area of West Africa south of the Sahara in the months of September and October, and one is tempted to suggest that there may be a southward migration from the edges of the desert belt at this time of the year corresponding to the northward movement about March. There is unfortunately a great scarcity of accurate records any farther south on the coast so that the suggestion cannot be confirmed. One must, as so frequently occurs in this study, await further evidence.

A remarkable record of the occurrence of *V. cardui* in mid-Atlantic is worth while drawing attention to here. Mathews (1865) records that on 4th August 1865 he was on board a battleship standing by the "Great Eastern" while she was laying the Trans-atlantic cable. The position was 51° 33' N. and 38° 17' W. The sea had been dead calm, "as smooth as glass" for several days. A "Painted Lady" butterfly was found alive floating on the surface of the sea, and about noon another was seen flying round the ship and continued to do so for the whole of the afternoon. The position is in the North Atlantic about 1100 miles due west of the south of Ireland and 500 miles east of Newfoundland.

Just over two weeks later they entered the harbour of St. John, Newfoundland, and found *V. cardui* in the greatest profusion, as it had been in Cork, Ireland, in mid-July.

It is almost impossible to believe that these butterflies had been unnoticed on the ship since leaving the Irish Coast three weeks before. The butterflies must have flown to the position when they were found.

(6) *Glycestha aurota* (= *Belenois mesentina* Cr.).

The following new records have come to hand since the publication of my previous summary (Williams 1930b).

1927, 1928 and 1929: Oct. and Nov. Pretoria, Transvaal. To N.

Vast numbers in early summer of each year. "One butterfly to every 10 yards in four or five tiers." As far as eye could see in all directions for one or two hours. E. G. Smith (Williams 1939b).

1928-29, Summer. Boshhoek, Rustenburg, Transvaal. To N.

Myriads on a warm afternoon with no wind: flight from 2 p.m. to dusk. Some low enough to go through fences, others above scrubby bush. No attempt to settle. Flying about 25 feet apart (G. W. Hockey mss.).

1930, Feb. 11-April 9. S.E. Kenya and N.E. Tanganyika. To S., S.E. and E.

Sixteen records received of flights between Mbule and Kikori in west, Ngari Nairobi and Voi (in Kenya) in north, Korogwe in south and the coast on the east, an area of about 280 by 150 miles (reported fully in Williams 1931).

1931, Dec. Barberton, Natal. To N.E.

Large numbers passed over for 2 or 3 weeks. Pearson (Williams 1936a).

1932, Jan. 28. Londiani, Kenya. To E.N.E.

Small but definite migration in teeth of steady breeze from E.N.E. Middle of dry season, no rain for six weeks. Some *C. florella* in flight. R. M. Graham (Williams 1933b).

1932, April 8-11. Londiani, Kenya. To E.N.E.

A second migration, no rain for nearly two weeks. Many specimens sent, all *G. aurota*. R. M. Graham (Williams 1933b). (Note that a few days later specimens were sent from a continuation of this flight and they were all *G. creona* = *severina*.)

1932, Dec. Barberton, Natal. To N.E.

Passed over for two or three weeks. Pearson (Williams 1936a).

1932 or 1933, March or April. Nr. Salisbury, S. Rhodesia. To S.E.

Steady stream of millions of white butterflies from 5.30 a.m. all one day and part of next—flying 10-15 feet above ground (G. T. Bennett mss.).

1933, March 1-15. Amani, Tanganyika. To E.N.E. and S.S.E.

Slight migrations from 1st March to E.N.E., but not noticeable to casual observers till 11th March, when it changed to S.S.E. and passed in larger numbers till 15th. Moreau (Williams 1935d).

1933, March 8. Limuru, Kenya. To N.

Started this year about 8th March instead of usual January and flew to N. instead of more usual S. Weather hot and little rain. Wind from south which was also unusual. Knight (Williams 1935d).

1933, March 12 and April 10. Londiani, Kenya. To N.N.E.

Most days wind strong from N.E. or N.N.E. Flight 10 a.m. to 4 p.m. Weather mostly bright and clear; rains overdue. Max. flight 100 insects per 100 yards square on 21st March. Graham (Williams 1934d).

- 1933, March 19-20. Njoro, Kenya. To N.
Flying in millions in unusual direction, flight normally to south. Dawson (Williams 1935d).
- 1933, March 28. Molo, Kenya. To W.
Passing for several days. Dawson (Williams 1935d).
- 1933, May, 1st week. Londiani, Kenya. To N.E. and N.N.E.
Small migration in usual direction, usually against the wind, rains about two months overdue. On 5th and 6th May up to 20 butterflies on 100 sq. yards. Graham (Williams 1935d).
- 1933, June 15-16. Gulf of Aden. ? To N.E.
Off Cape Gardafui and in Gulf of Aden; migrating from African Coast towards Arabia. Stoneham (Williams 1939b).
- 1933, July, about 5th. Off Cape Gardafui. To N.
Hundreds flying in face of N.E. monsoon. Seen from ship about 2 miles from shore. Several came to rest on deck. Flying from close to waves up to about 100 feet. Clear, hot (D. W. Howell mss.).
- 1934, Jan. Serowe, Bechuanaland. To N.E.
Millions crossed over, also reported 20 miles farther north (newspaper report).
- 1934, Jan. 20. Pretoria to Belfast, Transvaal. To E.
White butterflies flying in numbers. DuToit (Williams 1935d).
- 1934, Jan. 24. Potchefstroom, Transvaal. To N.E.
Vast numbers passed in afternoon. 100 in ten minutes passed a given point. Reported also from Johannesburg (D. P. Murray mss.).
- 1934, Jan., end. Lydenburg, Transvaal. To E.
Invasion of millions. Continuous stream seen all way from Petersburg to Rustenburg (newspaper report).
- 1934, Jan. and Feb. Windhoek, S.W. Africa. To N.W.
Migrating day after day across or with the wind on hills at about 1800 metres. One individual every 5 sq. yards. Occasionally stop to feed (K. Jordan 1936).
- 1934, Feb., beginning. Johannesburg, Transvaal. To E.
Millions passed for about 10 days. On 5th could have captured hundreds per hour. Wind variable and light. Weather sunny with occasional showers. Flying at ground level up to 30 or 40 feet. Many very worn. Adkin (Williams 1935d).
- 1934, Feb. 6-March, mid. Amani, Tanganyika. To S.
Small migration on 6th, increased to "rush" on 20th. After 28th decreased rather suddenly and only stragglers up to mid-March. Direction a few degrees E. of S. instead of more usual S.E. At peak 40 per minute on 15 yards front. Moreau (Williams 1935d).
- 1934, Feb. 11-15. Nairobi, Kenya. ? To or from S.S.W.
Flight in same direction as wind, "S.S.W.", but not clear if this is "to" or "from." R.A.S. (Williams 1935d).
- 1934, Feb. Londiani, Kenya. To N.W. or N.N.W.
Passing for a few days before 15th Feb.; on this day increased greatly in numbers. Wind N. in morning, changing to S.W. or W. in afternoon. Weather very dry. Thunderstorm and first rain for a month on evening of 14th. Maximum flight 15-18th. Graham (Williams 1935d).
- 1934, Feb. Meru, Tanganyika.
Flight as dense as a blinding snowstorm (M. E. Fountaine mss.).
- 1934, March 1-5. Johannesburg, Transvaal. To N.
Large migration. Traced on 5th as far as Nylstrom about 250 miles to north (J. S. Pringle mss.).
- 1934, Nov. 21 and Dec. 26. Graaf-Reinet, Cape Province. To N.E.
On 21st Nov. large numbers 7 a.m. in early morning, but all gone by midday. Very hot; wind strong N.W. A few seen in afternoon and stragglers in following week. Flight again noticeable on 26th December. Taylor (Williams 1935d).
- 1935, Nov. 18. Barberton, Natal. To S.W. or W.
Flight from about 10 a.m. to dusk. At house of observer flight to S.W., but at farm some distance away and round a bend in the hills direction to W. Slight breeze from N.E. 33 females and 21 males sent. Marshall and Pearson (Williams 1936a).
- 1936, March 5. Sudan. To W.
Large swarm drifting slowly to W. between Karma (lat. 13° 37' and long. 24° 18') and Om (lat. 13° 38' and long. 24° 35') on the Fasher-Kelkebia road. J. B. Cowland (Williams 1939b).
- 1937, Aug. Nairobi, Kenya. To E.
Thin migration with *C. florella* and *B. severina*. Rogers (Williams 1939b).

1937, Oct. 23-25. Trans-Nzoia, Kenya. To E.

Thousands in each morning. Wind strong from E. except on part of last day, when strong from W. On 25th, 65 per minute passing 50 yards front (Stoneham mss.).

1937, Oct., end. Thompson Falls, Rumarruti, Kenya. To S.

Millions passed in constant stream over front of many miles, reported by Conservator of Forests. Flying, according to newspapers, against a strong S. wind (T. W. Kirkpatrick mss.).

1937, Nov. 30. N.W. of Lake Victoria, Uganda. To E.

Thousands flying between Mahendi and Mityana. Wind N.E., force 2 (C. Longfield mss.).

1938, Feb. 2-17. Trans-Nzoia, Kenya. To E.

Generally hundreds passing, but thousands between 14th and 16th. Wind strong E. on 2nd and 3rd. Flying close to ground. Weather hot and dry (Stoneham mss.).

1938, Feb. 6-9. Amani, Tanganyika. To E.

Definite migration, winds light and variable, chiefly from N.E. (R. E. Moreau mss.).

1938, Feb. 10-17. Mt. Elgon, Kitale, Kenya. To S.E.

On 10th, 6-8 in sight at once. Weather dry, wind strong from W., which is unusual in dry weather. Flying 3-6 feet from ground. Locality 6700 feet above sea-level. On 11th January observer went 17 miles to east but no flight seen off slopes of mountain. Getting fewer till 17th, flight less definite and more to S. Wind gradually returned to more usual N.E. (E. M. Tweedie mss.).

1938, Feb. 15-19. N. side of Kilimanjaro, Kenya. To W.N.W.

On 15th marked migration at Engari-Rongai (6500 feet), wind light N.E. On 16th intermittent but at times copious migration over trees of forest belt 6500-8000 feet, and over heatherland at 8000, when very large numbers resting in sheltered places. Steady N.E. breeze all day. Between 17th and 19th Feb. each day slight but definite migration 8000-11,000 feet. Wind light N.E. (Moreau mss.).

1938, Nov. 27. Off Gambia Coast, W. Africa.

Flight seen from steamer 50 miles off Gambia Coast. Three captured (1 male and 2 females). In lat. 13° 27' N., long. 17° 36' W. (W. F. Palmer mss.).

1938, Dec. 2. At sea off Cape Verde, W. Africa.

Small numbers came on board ship 6-7 p.m. Ship had passed 2-3 miles off Cape Verde at noon going south. 2 captured (S. F. Clay mss.).

1938, Dec. 10. At sea off Dakar, W. Africa. ? To S.

Hundreds of white butterflies seen from noon to 3 p.m. Ship arrived at Dakar at 6 p.m. Butterflies flying S. Wind from N. Always 2-3 butterflies in sight. 3-20 feet above sea. Weather overcast and rather cool (M. F. Meiklejohn mss.).

1939, mid-Jan. Louisvale, Bechuanaland.

Sudden influx of white butterflies which appeared to arrive during the night and disappear next day, about three weeks before 5th February. Similar invasions noticed previously when they appear to come with a strong E. or N.E. wind. 4 specimens captured (B. T. Mennell).

1939, March 2-11. Amani, Tanganyika. To E. and N.E.

On 2nd marked migration to E. and N.E. On 3rd migration slight, wind N.E.; 4-10th very few; 11th rather more, wind very strong N.E., direction rather more northerly. 24 captured (R. E. Moreau mss.).

1940, March 22-27. Entebbe District, Uganda. To W.S.W.

Seen from Entebbe to Luzura and to Mawokoto border, also through Mengo and to Bugerera. Extreme line from Bugerera to Mawoke is about 140 miles. Continued each day from 7.30 a.m. to 6.30 p.m. At Luzira on 23rd, 21 per minute passing on 22-foot front. Were seen crossing the Nile from the eastern provinces in the Bugerere district. 39 males and 10 females captured (C. W. Chorley mss.).

In addition to the above records Mr. J. Peniston writes that he has seen migrations of white butterflies on three occasions at Weenen, Natal, always to the N.E. Also Hemming writes (1939, *Entomologist* 67: 135) that in Palestine the species is most common from August to November but that fresh specimens have been recorded in January (at Tabgha and at Jericho) and worn ones at Beersheba in April.

The above observations, together with those already summarised, give a total of nearly one hundred records. These are shown diagrammatically in

G. AUROTA (= B. MESENTINA)	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	MONTH NOT STATED
PALESTINE							↑						
EGYPT and SUDAN			←	•									
GULF OF ADEN						↗	↑						
UGANDA			←		↗							→	
KENYA	←	↑	↑	↑	↑		↖	→			→		
TANGANYIKA	↓	↓	↓	↓									
S RHODESIA				↓									
TRANSVAAL AND SWAZILAND	↗	↗	→							↖	↖	☉	
ORANGE FREE STATE, BECHUANALAND BASUTOLAND	↗	→									→	→	→
CAPE PROVINCE AND NATAL											↖	↖	↖
N W. AFRICA											↓	↓	↓
S.W. AFRICA	↖	↖											

34.

FIG. 34.—Diagram of recorded flights of *Glyceutha aurota* (= *Belenois mesentina*) in Africa.

fig. 34. From this it will be seen that the great majority of records are in Kenya and Tanganyika and in the months of February and March. In these two countries there are very few records at any other time of the year. In the southern portion of the continent the flights have been most frequently recorded in Natal and Cape Province in November and December, but in the Orange Free State and Transvaal etc., they are distinctly later in January to March.



FIG. 35.—Diagram showing flight directions of *G. aurota* in three different areas in Africa.

The few records in West Africa, in Gambia and off this coast are all in November and December.

The direction of the recorded flights in each of the three areas, Kenya, Tanganyika (almost all records in the N.E.) and the Union of South Africa are shown in fig. 35. From this it will be seen that in South Africa the flights are definitely towards the N.E. and in Tanganyika towards the S.E.; but in Kenya there is no prevailing direction.

It would appear that there is a source of migration somewhere in the south-west of South Africa whence come their flights, and that the flights in N.E. Tanganyika originate to the N.W. in Kenya; but the source of the Kenya flights is not definitely indicated. Pitman (1928, *Proc. ent. Soc. Lond.* 3: 45) has suggested that they originate in the Western Nile Provinces of Uganda, where, in 1928, he found the food-plant (Capparidaceae) abundant and defoliated by caterpillars of this butterfly over large areas. No migration was, however, noticed to be proceeding from here in spite of the vast numbers of butterflies present.

If this were the main source one would expect the flights in Kenya to show a more definite south-easterly or easterly trend.

(7) *Glycestha creona* (= *Belenois severina*).

The following are new records since my last summary (Williams 1930b).

1930, April 5-8. Karonga, Nyasaland. To S.E.

Passing for four days, 2 males, 2 females captured. Lilford (Williams 1933b).

1932, April 29-May 11. Mt. Elgon, Kenya. To N.E.

Occasional on most days, very thick on 6th May, steady stream on 7th, wind when recorded from N.E. slight to strong, females commoner than males (Moysey 1932).

1932, mid-April to beginning of May. Londiani, Kenya. To E.N.E.

A flight of *G. aurota* had been noted 8th-11th April (*q.v.*) and appeared to continue without break, but on 17th April 22 specimens captured were all *creona* (10 females and 12 males). On 17th wind from N.N.E. Flight continued spasmodically during rest of April. On 2nd May about 4000 per hour crossing 30 yards front. Graham (Williams 1933b).

1932, Sept. 7-8. Diarafabé, French Sudan. To W.S.W.

On 7th at noon flying along N. bank of River Niger, Wind fresh S.S.E., force 4, over by 4 p.m., many stopped to settle in flowers of tree, *Parkinsonia aculeata*. On 8th only slight flight, wind S.W., force 2-3; later same day dense swarm of locust passed to E. (O. B. Lean mss.).

1937, Aug. Nairobi, Kenya. To E.

Thin migration with *C. florella* and *B. mesentina* (K. St. A. Rogers mss.).

Dr. C. Seydel writes that he has seen this species migrating from W. to E. at Elisabethville, Belgian Congo, in May and November nearly every year. It is said there to feed on *Cereopetalum dasyanthum*.

This insect is a much less definite migrant than the previous species *Glycestha aurota*, but is frequently mistaken for it in flight and with many of the records of "White butterflies" in East Africa it is impossible to say which species was concerned.

It will be seen, however, from fig. 36, which contains all the known records which are definitely this species, that the time of flight in East Africa is distinctly different from that of *G. aurota*. The latter (fig. 34) started about the end of December and died away about April, whereas this species has most of its flights in East Africa in May and June with one flight in Tanganyika extending through July and August. This species also extends across into the Belgian

Congo, where there are several records of flight, but does not reach so far north in N. or E. Africa as does the previous species.

One of the more interesting records is that of April 1932 at Londiani, Kenya; Mr. Graham had noted a flight of white butterflies in the early part of the month (8th-11th) and had sent specimens all of which were *G. aurota*. About a week later (on the 17th), during which period the flight had not ceased, a number of specimens sent were all *G. creona*.

G. CREONA = B. SEVERINA.	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	MONTH NOT STATED
FRENCH SUDAN									↙				
KENYA				↗				→					↓
UGANDA				↘	↙	↘							
TANGANYIKA						↘	→	→	→	→		↘	
BELGIAN CONGO					↗						↗		
NYASALAND				↘									
RHODESIA												↘	
SOUTH AFRICA		+	↗	↗	↗								

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FIG. 36.—Diagram of recorded flights of *Glycestha creona* (= *Belenois severina*) in Africa.

These two butterflies make an interesting example of the necessity of careful identification in the field, and of the need of getting a number of specimens at intervals during the same flight.

(8) *Glycestha (Belenois) java teutonia*.

Glycestha java is the only "white" butterfly of which I have definite records of migration in Australia. On several occasions statements have been made suggesting that some species of *Delias*, possibly *D. nigrina* or *D. harpalyce*, also migrate, but in spite of many enquiries I have been unable to get any confirmation in the form of actual specimens caught during a migration.

In my previous summary (Williams 1930b) I was able to give about a dozen records of flight of *G. java* and the following are additions to this list.

1882, Feb.-April. Nr. Rockhampton, Queensland.

B. teutonia and *Catopsilia pomona* literally swarmed for a time and for a few days fell like snow in streets of Rockhampton (G. Barnard 1883).

1886-7, summer. Melbourne, Victoria.

Simply swarmed in the district (Lucas 1887).

1920-21, Dec.-Jan. Glass-house Mts., Queensland.

Puxley (n.d.) repeats the account previously quoted (Williams 1930b) but gives the date as December or January instead of September.

About 1921. Near Brisbane, Queensland. To S.

One day, about fifteen years before 1936, clouds flew over Stradbroke Island, about 20 miles S. of Brisbane, in close formation (Wilkinson mss.).

? 1933. Morea, N.S. Wales. To N.W.

Countless thousands seen by Mr. A. Musgrave. Found breeding in great numbers on wild orange and wild pomegranate (newspaper report).

1934, ? Dec. Coldstream, nr. Melbourne, Victoria. To E.

Thousands passed over farm, some settling (newspaper report).

1935, about January. Sydney, N.S.W. To E.

Millions flying through town and out to sea. Flying low near ground. Irvine (Williams 1936a).

1935-36, summer. Southern Victoria. To S.

Myriads flying, very abundant on Phillip Island, Western Port Bay, as well as on mainland (C. Barrett mss.).

1937, end Jan. or beginning Feb. Sydney, Australia. Approx. to N.

Flight for two days, but less dense on second; observed at Lane Cove River, about 4 miles N.W. of Sydney. Flight chiefly 2-3 feet above ground, rose vertically over buildings and descended again into a quadrangle; about 70 per minute on 90-foot front at 2-3 p.m. and over 100 per min. on 85-foot front between 4 and 5 p.m. (N. Burke-Gaffney mss.).

1938, Jan.-Feb. Edgecliff, Sydney. To N.E.

First specimen, a male, seen on 1st January. On 10th January, thin migration, 310 females and 519 males passed through gap in hedge in 3 hours, all to N.E.; flew from garden out over water at Rose Bay. Flying 2-8 feet about ground. Following day only a few stragglers. On 17th, 25th and 27th January and 12th February very occasional males seen passing to N.E. On 29th March about 10 males seen passing to N.E. (A. D. M. Busby mss.).

1938, Nov. Sydney.

Thousands of small white butterflies have invaded the coast round Sydney, drifting with the wind (Sydney newspaper of 11th November 1938).

1938, Nov. 9-11. Sydney. To N.

On 9th November a boat crew on river was "greatly incommoded" by thousands of butterflies: wind a little W. of N., force 1. Temp. 87° F. On 10th flight continued. Thirty butterflies seen round one bush: speed about 6 m.p.h., temp. 97° F., wind almost W., force 3: many seen sleeping in pine trees in evening. On 11th at 9 a.m. 20 individuals timed over measured 200 feet with stop-watch: speed varied from 4 to 10 m.p.h. with average just over 8; wind S., force 1: flying 2-20 feet from ground, majority about 6. Numbers crossing 100 feet of hedge average 20 per min. for 15 minutes. At 10 a.m. 500 passed in 15 minutes on a 180-foot front. Ten tests for speed at this hour gave 6½ m.p.h. Only few stragglers left at 2 p.m. On 12th many about but not moving in any definite direction (N. Burke-Gaffney mss.).

1939, Nov. and Dec. Sydney. To N., N.N.E. and W.

On 15th November one male flying to north. On 3rd December 10 to 15, mostly males, flying to N.N.W. about 5-10 feet from ground. On 11th December small flight in morning for about 2 hours, about 15 feet above ground. Rather denser flight for about 3 hours in afternoon. To N.N.W. On 14th December very thick flight, thousands and thousands, flying to west (unusual direction). Wind light from E. but not enough to affect butterflies. Valerian in garden weighed down with butterflies settling on it. First noted 8 a.m., all gone by noon. Thirteen males and 2 females captured (A. D. M. Busby mss.).

In addition to the above records, which are more or less definitely *Belenois java*, Mr. A. D. M. Busby gave me the following notes on a flight of white butterflies that he saw in the Yarraman Valley, Liverpool Range, N.S. Wales, in December 1907, all flying from south to north.

Large numbers of butterflies with black tips to wings and marked beneath with red and yellow were migrating. The flight was about 3 miles wide and outside this there were no butterflies. The edge of the flight was so definite that although large numbers were passing through the front of his house, which was on one edge of the flight, none could be seen at the back of the house. The butterflies were flying from about 3 to 20 feet above the ground. They were first seen at sunrise, rested at midday and resumed again at 2 p.m. till sundown, when they rested for the night. One Jasmine shrub in the garden was drooping with the weight of the butterflies settled on it. On the following day millions were in the air at sunrise; during the day the numbers reached 30-40 per square yard. Again they rested at midday and resumed their

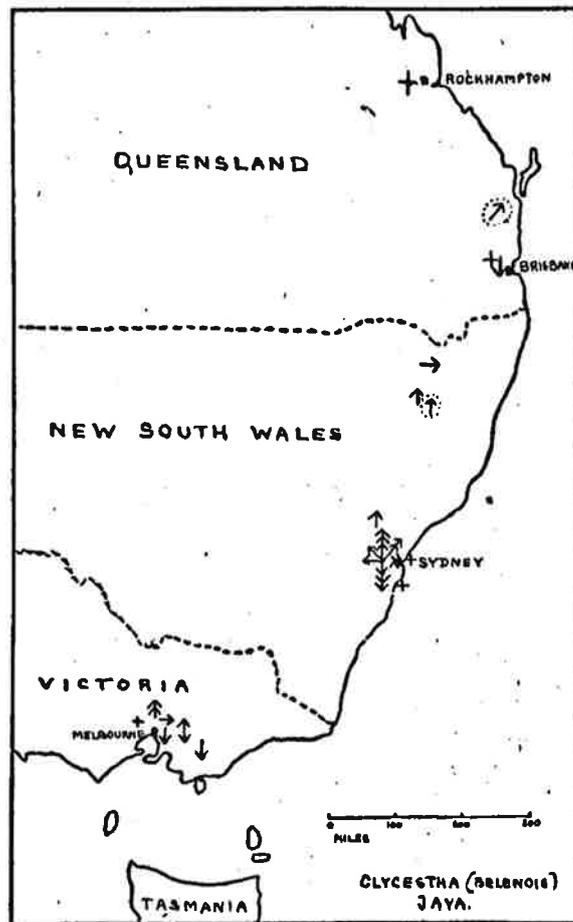
flight, almost simultaneously at 2 p.m. On the third day there were fewer and on the fourth only stragglers. Mr. Busby notes that the ordinary common field butterflies seemed to be greatly bewildered by the flight and hid themselves in the crops and grass during most of the migration.

GLYCESTHA (BELENOIS) JAYA.	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	MONTH NOT STATED
QUEENSLAND	↑ ↓	☼							☼			☼	↓
NEW SOUTH WALES	☼ ↓	↑								↗	↓ ↓ ↓	☼ ↑	
VICTORIA	☼										↑ ↑	☼ ↓	↑ ↓

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FIG. 37.—Diagram of recorded flights of *Glycestha (Belenois) java* in Australia.

About 80% of the butterflies were whitish with a darker margin above, and about 15% with much more black above. In addition Mr. Busby recollects red and yellow markings beneath. These were undoubtedly male and female



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FIG. 38.—Map showing recorded flights of *G. java* in Australia.

of a Pierid, but it is not possible to say definitely if it was *Belenois java* or a species of *Delias*. Mr. Busby (see above) has since seen *B. java* migrating in Sydney but he thinks that the Liverpool Range butterflies were rather larger.

In the flight also were about 5% of a "swallow tail," which appears from a sketch made at the time to be *Papilio aegaeus*, a species that has not previously been recorded as a migrant.

Alexander (1917) records that *java* became suddenly abundant in the neighbourhood of Perth, S.W. Australia, in the summer of 1914-1915, together with *Papilio demoleus sthenelus*, *Terias smilax* (first time recorded in the S.W.) and incredible numbers of *Danaida chrysippus petilia*. This is the first indication of migration of any *Lepidoptera* in the western half of Australia.

Fig. 37 shows diagrammatically all the recorded directional flights of *G. java* in Australia arranged according to the month in which they occurred. It will be seen that the majority are in November, December and January. The only records between March and September are doubtful, and in fact, the "September" record by Puxley, was in a later account given as "December or January." The period of flight corresponds with the spring season in that part of the world.

Fig. 38 shows the distribution of the flights geographically and one immediately sees the number of records concentrated round the large towns, due to the greater chance of the presence of an interested observer. From the most southerly record in Tasmania to the most northerly at Rockhampton the distance is about 1200 miles.

(9) *Catopsilia florella*.

The following records are not included in my 1930 summary for this species.

1925. Stanleyville, Belgian Congo.

Unusually abundant at the beginning of the "strong" rains, but not moving. Ghesquière (1932 : 301).

1929, Aug. Kadaru, N. of Khartoum, Sudan.

About 50 acres of Senna (*Cassia* sp.) severely damaged by larvae of *C. florella*. Bedford (1930, *Sudan Ent. Bull.* 31 : 38).

1932, Jan. 28. Londiani, Kenya. To E.N.E.

With *B. mesentina* and others in small flight against a fairly steady wind. Graham (Williams 1933b).

1932, April 17. Londiani, Kenya. To N.N.E.

One sent from a migration of *B. severina*. Graham (Williams 1933b).

1932, June 3-10. Kiminini, Mt. Elgon, Kenya. To S.W. or S.

On 3rd steady flight to S.W.; no wind; 24 in 15 minutes on a 30-yard front. On 4th June to S.W. or S., no wind. On 6th June wind N.E. flight S. From 7th-10th June irregular flow about 1 per minute continued. Moysey (Williams 1933b).

1933, March and April. Londiani, Kenya. To N.N.E.

A few in migration of *B. mesentina*. Graham (Williams 1935d).

1934, Jan. 3-end. Londiani, Kenya. To N.W. and N.N.W.

On 8th up to 10 on area 30 yards square. Flying fast but a few stopped to feed. Wind steady from N.E. Some rain E. of Londiani but none there. Note that direction of flight is unusual. Graham (Williams 1935d).

1934, March 7-9. Gatooma, S. Rhodesia. To E.

Large number passing high overhead. Reported also 20 miles away. Continued for 3 days, when heavy rainstorm in evening. Next day none. Many other species included in flight. Houston (Williams 1939b).

1934, May 29-June 2. Amani, Tanganyika. To slightly W. of S.

About 10 per min. passing on 100-yard front, with very rapid flight. Moreau (Williams 1935d).

1934, Dec. 24-28. Amani, Tanganyika. To S.E.

Definite migration reported. N.E. wind had started. Flights at this time of year usually to N. Moreau (Williams 1935d).

1935, Jan. 8-17. N.E. Tanganyika. To N.

Flight across Ngorongoro Crater on 8th, a few points W. of N. descending the steep sides of the crater to the bottom. Also strong at Mbulu from 12th-17th, steady and often strong N.E. wind blowing day after day. Moreau (Williams 1935d).

1935, Feb. 6-10. Amani, Tanganyika. To N.

On 10th migration seen from Amani for about 10 miles towards the coast, but not nearer coast than this. Wind strong gusty S.E. Moreau (Williams 1935d).

1935, April 9. Barberton, S. Africa. To E. or N.E.

Steady flight against "fresh breeze," of about 20 m.p.h.; 63 seen in 45 min., of which 32 to East. Marshall (Williams 1936a).

1935, Dec. 26-29. Gatooma, S. Rhodesia. To S.E.

Singly or in pairs all day. Against E. or S.E. wind of 1-3 force, fine and bright, flying low. Last rain on 21st December. Peat (Williams 1939b).

1936, April 17. Off Aden. (N.)

One seen about 30 miles E.S.E. of Aden (Moreau mss.).

1936, —. Salisbury, S. Rhodesia. To N.

Seen in flight of *B. gidica* (Cuthbertson mss.).

1936, Nov. 3-4. Lundari, N. Rhodesia. To E.

Numerous all day. Winterbottom (Williams 1939b).

1936, Nov. 13. Nr. Gatooma, S. Rhodesia. To W.

Flying strongly between Gatooma and Umsweswe, just above ground—widely spaced 10 a.m. to evening. Wind very slight. Rainy season just commenced. Houston (Williams 1939b).

1936, Nov. 29. Fort Jameson, N. Rhodesia. To W.

Winterbottom (Williams 1939b).

1936, Dec. 22-Jan. 6, 1937. Umsweswe, S. Rhodesia. To S.E.

On 22nd hundreds flying low with light breeze. On 23rd and 27th greatly increased numbers, then steady decrease. A few only on 6th. Houston (Williams 1939b).

1936, Dec. 26. Fort Jameson, N. Rhodesia. To W.

Weather hot. Winterbottom (Williams 1939b).

1937, Feb. 7-18. Barberton, Natal. To N. and E.

Gradually more abundant. On 18th 207 in 15 minutes with 93 to N., 23 to N.E. and 33 to E. Wind gentle E. Marshall (Williams 1939b).

1937, March 22-24. Springs, Transvaal.

Appeared in hundreds with many *D. chrysippus*. All gone a few days later, but no directional movement noted. *C. florella* not known to breed in this area (Murray mss.).

1937, Aug. Nairobi, Kenya. To E.

In thin migration with *B. mesentina* and *severina*. Rogers (Williams 1939b).

1937, Dec. 17-25. Fort Jameson, N. Rhodesia. To E.N.E. and N.E.

On 17th at Fort Jameson in ones and twos heading N.N.E. almost directly into stiff breeze 9 a.m.-4 p.m., all within few feet of ground. On 19th denser and to N.E. till 2 p.m., when heavy storm (Winterbottom mss.).

1938, Jan. 14-15. Trans-Nzoia, Kenya. To W.

Scores passing 10 a.m.-2 p.m. 6-7 feet above ground. Wind light easterly (Stoneham mss.).

1938, Dec. 30-Jan. 15, 1939. S.W. Uganda. To N.

Steady movement over lakes Mutanda and Mulehe throughout the day. Wind steady from N.W. and N.E. Always at least six in sight on lake (Pitman mss.).

1939, April, end. Salisbury, S. Rhodesia. To N.E.

Passing in small numbers in last week in April (Cuthbertson mss.).

Fig. 39 shows diagrammatically the recorded flights according to country and the month of the year.

It will be seen that most of the records are in Kenya and Tanganyika from the end of December to the end of April, with a few in May and June. Farther south the period without flights lengthens and in Transvaal, Natal and the Cape Province there are no flights from mid-April till the end of December.

In Northern and Southern Rhodesia the flights seem to start earlier in November.

Fig. 40 shows rosettes of the recorded flights for each main area. In Kenya and Uganda the majority are to the N. and N.W. In Tanganyika there are flights to N.E. and S., but none to the W. In N. and S. Rhodesia there are