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Synchronous Flashing of Fireflies in New Guinea[1]

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(with 2 Plates)

ニューギニアの螢の同時明滅について

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In tropical Asia countless number of fireflies, gathering in big trees, can be seen to flash in synchronization as though the tree itself were breathings. This synchronous flashing of fireflies is not a rare or unusual phenomenon but can be seen only in a specific season of the year. According to Harvey's book (1952) early travelers in Thailand were particularly impressed by the display which is one of the peculiar sights of tropical Asia. REINKING (1902) and MORRISON (1929) made a scientific description of the phenomenon.

Dr. and Mrs. John B. Buck who attend the Conference on luminescence, held at Hakone national park, Japan, in September 1966, had a trip to Malay, Thailand and to North Borneo after having left Japan, and observed synchronous flashing of fireflies. The results of the observation by the said specialist of firefly is expected to add much to the study in this line.

According to observations made by the author on the synchronous flashing of fireflies on his several collecting expeditions in tropical areas since 1937, the phenomenon has been seen on a small scale everywhere in tropical Asia, but most often in New Guinea and adjacent islands, where the displays are larger and more beautiful. There appears to be several species of fireflies that tend to synchronous flashing at least in tropical Asia, and the interval of the rhythm of flashing varies in different fireflies.

1. Observations in Rabaul, New Britain

The author's first observation was in March, 1940 at the Rabaul Botanical Garden,

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Rabaul, New Britain. The results of this observation, have already been described in 1941 and 1955.

On the leaves of a large silk tree countless numbers of fireflies were alighting and flickering rhythmically, causing the whole tree to appear as if it were breathing.

The flicker was transmitted rhythmically, the upper group extinguishing its light first, followed by the middle group, and last the lower group. Sometimes the rhythmical flashing was transmitted from the lower part to the upper. The flashes were repeated at the amazing speed of seventy per minute.

The fireflies were small with black wings and orange thorax and were 7 mm long. The male has two segments of the luminous organ, and the female has one.

The synchronous flashing lasted from sunset to dawn, notwithstanding the rain. It was similar to that reported by SMITH (1935), except that he noted the phenomena occurring when the moon was half full. Even after dawn, with the sun shining brightly, the fireflies remain upside down on the leaves of the tree. 60% of the fireflies on the tree were males. This fact differs from the observations of MORRISON and SMITH, who thought that the fireflies on the trees were all males and that the whereabouts of the female was unknown. They thought that the males fly from the jungle for the display.

Obervations of flashing were made in the dark with almost equal number of males and females, each in separate cages. Only the males continued to flash synchronously. On the contrary, the females showed irregular flashing. The color of the light of the males is bluish while that of the females is yellowish. The difference is discernible with the naked eye. The light looked like a scattering of yellow and blue powder when the branch of tree was shaken at night. In the author's former report (1941 and 1955) the color of the light was described as yellowish for the males, bluish for the females. The author wishes to correct this here. Many copulating fireflies were found on the grass under the tree, and at that time the males were not emitting light, and the females were emitting weak light.

The valuable specimens were lost by fire in Tokyo in 1945, but the author had an opportunity to visit Rabaul again in April 1965.

Though unable to observe a synchronous flashing as splendid as the one he saw in 1940, he did observe the color of the light and obtained enough materials to study. Through the courtesy of Mr. G. DUN, Principal Entomologist of Keravat Agricultural Station, 20 miles from Rabaul, he also received about two thousand specimens of fireflies both dried and preserved in alcohol.

An experiment with ATP on the dried luminous organs was performed as follows. The luminous organs of 300 dried specimens of the male, and 300 of the female were cut off and ground separately in a mortar. The colors emitted by the preparations in a dark room, after adding ATP and water, were compared. The color difference between the preparations from the male and female was clearly discernible with the naked eye. The male preparation emitted bluish light, and the female yellowish.

Specimens of the fireflies were sent to the British Museum through the courtesy of Dr. J. J. H. Szent-IVANY, Senior Entomologist, Department of Agriculture, Stock and Fisheries, Port Moresby, Territory of Papua and New Guinea, and were identified by Dr.

R. G. FENNAH, Common Wealth Institute of Entomology, British Museum (Natural History), London as *Pteroptyx sp.* near *microthorax*. Mr. Frank A. MCDERMOTT of Delaware, U.S.A. identified as *Pteroptyx cribellatum*.

2. Observation in Irian Barat (West New Guinea)

In March 1943, the author observed again this beautiful synchronous flashing of fireflies at Manukuwari, Momi and Walen in Irian Barrat, Indonesia.

The fireflies were larger than those seen in Rabaul. They were 7.0 to 7.5 mm. in length with brown wings and differed in the following respects from the fireflies in Rabaul.

a) The color of the light is bluish in both male and female.

b) The synchronous flashing arose from both male and female; almost equal numbers of males and females gathered on one tree.

c) The fireflies have a migratory tendency, assembling one by one in large groups, then moving to another tree. Their whereabouts in the daytime is unknown. The innumerable fireflies on a row of silk trees were seen flashing as if light waves moved from one end to another of the row of trees. The scale of synchronous flashing is much more larger than that of Rabaul.

3. Observations in the Territory of Papua and New Guinea.

Synchronous flashing of fireflies was observed by the author in April 1965 at Bulolo, Wau and Madang in the territory of Papua and New Guinea. The fireflies with brown wings collected in these districts are considered to be a species similar to that seen in Indonesian New Guinea. Mr. MCDERMOTT identiffied this specimens as *Pygoluciola* sp. Peculiarities noted on this occasion are as follows.

a) The synchronous flashing occurard in several groups of fireflies on one big tree in the jungle, instead of in one group as a whole throughout the tree; *i.e.* different groups made independent synchronous flashing and they were not affected by the light of other groups, even those close by.

b) The intervals between flashings were comparatively long, and the duration of flashing was very short, like a flash of lightning. Flashing occurred at intervals of 6 seconds. Since there were as many as ten groups flashing independently, the total effect was that of a display of fireworks.

蛍が木に無数に集って，木があたかも呼吸をするように同時に明滅する現象は東南アジアの夜を飾る一つの壮観である。従来多くの人々によって観察結果が報告されているが，必らずしも観察は一致していない。

1965 年 9 月，箱根で行った生物発光の学術会議に出席した蛍の専門家である，Dr. John B. BUCK 夫妻は会議後，この美しい光景を見るため，マラヤ，北ボルネオ，タイ国を旅行しその観察結果と，過去の多くの観察結果とを比較検討した私信をよせて来た。

過去の多くの観察が一致しない理由について，著者の過去の観察結果を要約してみると

（1） 同時明滅をする蛍は東南アジアでは一種類ではなく，少なくとも数種類がみられるが，その種名がほとんどわかっていない。

（2） 同時明滅の一分間の回数，集まる木の種類，雌雄の行動，その他習慣は，種類によって異

るので，同時明滅を観察する時は種名をまず明らかにしなければならないのに，多くの報告は種名が明らかでない。

蛍の同時明滅は東南アジアでは決してまれな現象ではないが，いつでも，どこでも見られる現象でもない。季節と関係があり，地域的に違いのあるのはもちろんである。

1937 年以来，著者の数回にわたる東南アジアの旅行中，観察したものの中，特に大規模な驚くべき美しい光景はニューギニアおよびその周辺の島々にみられるのでその二，三について述べてみる。

（1） ラバウルの螢

著者がはじめて，ラバウルの蛍の明滅を観察したのは 1940 年 9 月である。体長 7 mm 翅の黒い，胸部のオレンジ色の蛍で，ラバウル植物園内のネムの大木に無数に群っていた。一週間の観察結果によると，蛍はネムの葉にとまったまま昼間は熱帯の太陽の直射を受けながら葉の裏側にとまっていた。月の光も雨の夜もほとんど影響されず止まっていた。要点を列挙すると，

（A） 雌雄共に集るが，雌は少なく 40%，雄は 60% 位である。

（B） 発光は電光的で消光する時は全く消えてしまうので明滅がはっきりしている。

（C） 小さいグループでは明滅は同時に行われるが，大きなグループ，例えば大きなネムの木では光の波となって木の上から下方へ，ある時は下から上へと光の波が走る。

（D） 同時明滅をしている大きな蛍の群に強い懐中電燈の光をあてると同時明滅が乱れて一時混乱状態になるが電燈の光を消すと再び 30～40 秒後に同時明滅をくり返す。明滅の回数は一秒間 70 回

（E） 最初にペースメーカーが光るとそのすぐ近くの個体が光り，次々と光が伝わって，発光の時間が僅かずつおくれるため，光の波となるのではなかろうか。

（F） 雄と雌を数百ずつ別々にして観察すると同時明滅は雄のみで，雌にはこの性質がないことがわかった。

（G） 雄の光の色は青色で，雌は黄色で，光の色だけで肉眼で区別できる。木の下で小枝をゆすぶると，黄色と，青色の光の粉が飛びちるようで極めて美しい。

（H） 木の下の芝生の上には多くの交尾中の蛍をみかけた。交尾中のものは雄は消光し，雌はかすかに光っていた。

（I） 蛹も発光し，土から僅かばかり出て光っているものを見た。幼虫は採集できなかったが，恐らく陸棲でこの木の附近から発生するものと思われる。

この蛍の標本は 1945 年東京で戦災のため消失し，同定の機会を失ったが，幸にも 1965 年 4 月再びラバウルを訪れる機会を得，発光を観察すると共に種名を確めることができた。この蛍はマックデルモット氏により *Pteroptyx cribellatum* と同定された。蛍の乾燥材料を雌雄，それぞれに分けて，発光器を切りとり，ATP を加え，明らかに肉眼で，青色と黄色の異った光を得た。

（2） 西イリアン（西ニューギニア）の螢

1943 年 3 月西イリアンのマヌクワーリ港からヘールフィンク湾を下ってモミ，ワーレンを訪れた時，観察したもので，ここの蛍の同時明滅はラバウルよりさらに大きな規模で驚くべき景観であった。

（A） 蛍は翅の色が褐色で体長，7.0～7.5 mm 雌雄がほとんど同数集まり，移動性である。夕方どこからともなく，一つずつ集まり一，二時間の中に大群となり，明方にはまた，どこかへ飛び立って行く。しかも毎夜同じ木に集まるとは限らず，昨夜集っていたと思って行ってみるとその夜は一頭もいない場合もあった。

（B） 雌雄による光の色の差はなく，共に青緑色である。

（C） 同時明滅の様子はラバウルの蛍と同様で電光的で，一分間の明滅の回数は約 70 回，光の波が走るようである。規模は極めて大きく，一本の木の場合もあるが，モミでみた光景は十数本のネムの木の並木の端の木から他の端の木まで光の波が横に道に沿って走るような光景であった。木の近くへ行くと，蛍は葉に止っているものは少なく，，葉のまわりを群り飛びつつ明滅をしていた。あたかももやもやと火の粉が舞い上るような光景であった。

（3） 東部ニューギニアの螢

パプアおよびニューギニアの高原の町，ブロロ，北海岸のラエとマダンでみた蛍は翅の色が褐色，体長 7～7.5 mm 西イリアンの種類に近いものと思われる。マックデルモット氏はこの種類を *Pygoluciola* と同定した。

この蛍は大きなジャングル内の木に小グループを作り，一グループは同時明滅を行うが，隣接のグループとは無関係である。明滅の回数が少なく，消光している時間の方が長く電光的な光は瞬間的で 6 秒の間隔をおいてぱっと光る。大きな木では小グループが十以上もあるため，木全体としては強い光が木のあちらこちらに現われるので丁度，線香花火のような感がする。雌雄による光の色の差は認められない。

以上は著者のニューギニアにおける僅かな観察であるが，蛍の種類によって，発光の状態や，習性が異ることがわかる。

蛍が集まる木については従来，タイ国やマラヤでの観察では多くはマングローヴに集ることが記録されているが，著者の見たニューギニアの蛍は，主として，ネムの木であった。しかし，時に，椰子の葉のまわりや，木に止まらず空中に小グループとなり停止状態で飛びながら，同時明滅をしているのも見られた。

同時明滅は一見単純な蛍の明滅現象のように思われるが詳細に観察すると，複雑な発光現象であり，種類，地域によってそれぞれ特徴があるので，多くの人の観察結果を検討することが重要である。

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Fig. 1. Silk tree to which fireflies sometimes swarm, near the botanical garden of Rabaul, New Britain.

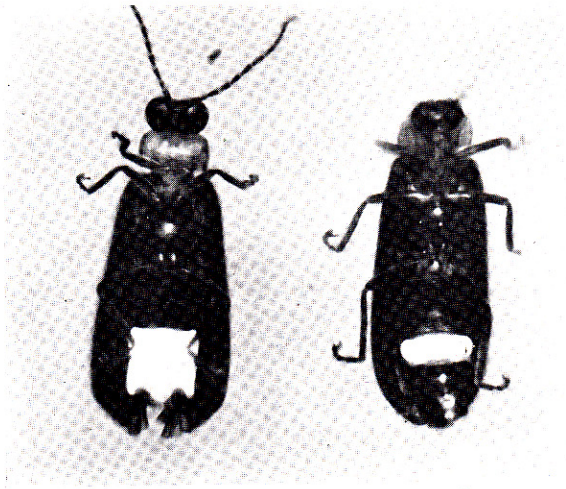

Fig. 2. *Pteroptyx cribellatum* ×6 from Rabaul, New Britain, Male (left) and Female.

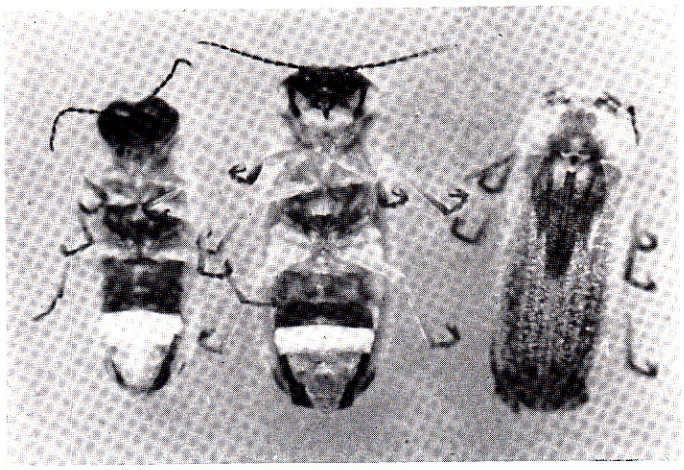

Fig. 3. *Pyroluciola* sp. from Bulolo, Territory of Papua and New Guinea, Male (left) and Females. ×6