

The Great Lakes Entomologist

Volume 2
Numbers 3/4 -- Fall/Winter 1969 *Numbers 3/4 --
Fall/Winter 1969*

Article 2

June 2017

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Recommended Citation

Wilkinson, Ronald Sterne 2017. "Townend Glover (1813-83) and the First Entomological Light Trap," *The Great Lakes Entomologist*, vol 2 (2)

DOI: <https://doi.org/10.22543/0090-0222.1100>

Available at: <https://scholar.valpo.edu/tgle/vol2/iss2/2>

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TOWNEND GLOVER (1813 - 83) AND THE FIRST ENTOMOLOGICAL LIGHT TRAP

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I. Townend Glover

Townend Glover, first U.S. Department of Agriculture entomologist and unacknowledged inventor of the first successful light trap for insects, was one of the more interesting entomological investigators in mid-nineteenth century America. Modern historians who have written brief notices of Glover have gained most of their information from a very rare Government pamphlet by his friend and assistant Charles Dodge (1888), who unfortunately does not mention the matter of the light trap at all. The present account, assembled from various nineteenth century sources, briefly summarizes Glover's career and presents evidence for his invention of the portentous "American Moth Trap."



Townend Glover, from the frontispiece in Dodge (1888).

Glover was born on 20 February 1813 at Rio de Janeiro, where his English parents were building a comfortable fortune at trade. Henry Glover lost his wife Mary only six weeks after the birth of their son, and was forced to send young Townend to the care of relatives in England. The boy showed an early aptitude for drawing, and soon developed a love of natural history. A patrimony inherited in 1834 made him financially independent, and after two years spent on the Continent in the study of German and painting, Glover decided to visit the United States. He sailed in June 1836 and toured the Eastern seaboard before deciding to establish himself at New Rochelle, New York. In September 1840 he married Sarah Byrnes of Fishkill-on-the-Hudson, and lived in that picturesque village afterwards as a country gentleman, conducting research in pomology and writing for the *American Agriculturist*.

In June 1854 Glover accepted a position in the newly formed Bureau of Agriculture, then part of the United States Patent Office. His duties were extensive, involving travel as 'special agent' as well as routine work in economic entomology. He visited Venezuela and British Guiana in 1856-57 on a non-entomological mission to procure sugar cane plants for the restocking of depleted Louisiana plantations. His pioneer Government appointment enabled Glover to undertake really significant research on grape insects and cotton pests, which has been summarized by Dodge (1888). His investigation into the problem of the orange scale was conducted until 1858, but by this time he was quarreling constantly with D. J. Browne, chief clerk of the Bureau. The conflict with Browne led to Glover's resignation from the Patent Office early in 1859.

While satirizing his enemy in a series of articles written for the Washington press, Glover sought employment, finally securing the chair of natural sciences in the Maryland Agricultural College. Here he began his vast *Illustrations of North American Entomology*, which would be privately published nineteen years later.

Glover had learned to engrave long before his Government service. His attempts at entomological illustration had been praised by the great Harvard naturalist T. W. Harris in 1852, and in 1854 or 1855 Glover conceived a series of 'pocket plates' to depict and help identify economic insects. While with the Patent Office he executed a number of illustrations of cotton and orange insects originally intended for separate publication. As early as 1855 he experimented with the direct transfer process by which the scales of Lepidoptera were removed with gummed paper to give tolerable representations, but he discarded this method as unsatisfactory. Not until the relative freedom enjoyed after his resignation from the Patent Office was Glover able to undertake the broader idea of the *Illustrations*, which eventually numbered two hundred and seventy-three plates. He engraved on copper between lectures and field trips at the College, according to a trying schedule which would later influence his health.

In April 1863 Glover was appointed United States Entomologist, the Department of Agriculture having been established in the previous year. He now applied himself to a more rigorous schedule, rising at five in the morning to engrave his plates before beginning the day's work at the Department. Upon leaving the office at three in the afternoon, he worked at the *Illustrations* until late at night.

Glover's research in economic entomology during his employment with the Department of Agriculture was so varied that his yearly reports must be consulted for a proper appraisal of his efforts; references to his many Government publications would be out of place in a brief biographical sketch. One of his favorite projects was the development of a Department museum, to which he devoted a great amount of labor. Unfortunately the insect collection was not well kept, for after Glover figured a specimen he had little regard for it. His assistant Dodge describes him as extremely careless in mounting insects and preserving them from pests, mould and verdigris. Yet the plates received their deserved reward. Glover travelled to Europe in the summer of 1865 to attend the Paris exhibition of insects and insect productions, at which a coloured set of his first hundred and thirty plates was given the highest award, a gold medal from the Emperor Louis Napoleon.

In 1871 Glover decided to publish at least part of his *Illustrations* as a preliminary example of the work in hand. *Illustrations of North American Entomology . . . Orthoptera* appeared in 1872, with thirteen plates depicting over two hundred named species. The text was deficient, and hardly represented Glover's extensive study of the order as revealed in his minutely written notebooks. Two hundred and fifty copies were printed at a private press in Washington, D.C., but only fifty copies were bound and distributed *gratis*. The remainder seems to have been sold for waste paper, in keeping with Glover's characteristic disregard for furthering his own reputation.

The work on the Orthoptera was followed in 1874 by the first of three curious extracts from Glover's manuscript journal of species habits. *Manuscript Notes from my Journal or Illustrations of Insects, Native and Foreign Diptera* was printed in direct lithographic transfer from Glover's journal by his friend James Gedney. The volume was illustrated by twelve plates depicting various stages of over three hundred species. Only forty-five copies were printed, and these were distributed free according to Glover's habit.

During the 1870s Glover's habits became more eccentric and solitary than before. His 'official' publications were numerous. The second in the series of *Manuscript Notes*,

covering the Heteroptera, appeared in an edition of fifty-three copies in 1876. There were ten plates, of which nine were coloured. An index to economic insects mentioned in agricultural reports was published as the third volume of *Manuscript Notes* in 1877.

The complete *Illustrations of North American Entomology*, one of the rarest of all entomological books, was finally published in 1878. The work included plates of insects then within the Coleoptera, Orthoptera, Neuroptera, Hymenoptera, Lepidoptera, Homoptera and Diptera. There were also twenty-two plates of cotton insects, making two hundred and seventy-three plates in all. Only twelve copies were printed, and ten were distributed to institutions, five in the United States and five in Europe. Glover kept two copies, which were sold with his library after his death.

Although Glover's *magnum opus* was praised by such influential scientists as Louis Agassiz, comparatively few entomologists have ever seen a copy. Undeniably the plates cannot compare with the best attempts at entomological illustration in the nineteenth century. Some of the figures are quite inaccurate, but the value of the work lies in its brave concept. No one before had attempted to illustrate such a large variety of American insects; the *Illustrations* contain 6,179 figures of economic and other species. There was little text, a deficiency which Glover might have remedied had his health remained. He planned to enlarge the work and publish it in quantity at low cost, but serious illness intervened in 1878. He was obliged to retire from the Department of Agriculture, and was replaced in June by the better-known Charles Valentine Riley.

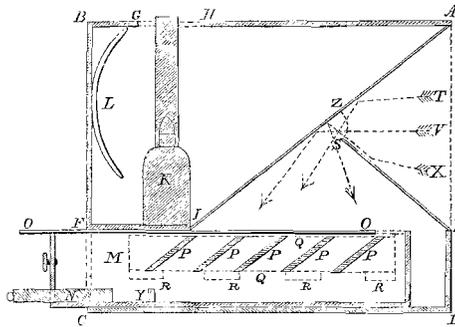
Glover died on 7 September 1883 after a long period of ill health. Six months earlier the U.S. Government had paid him \$7,500 for the original copper plates to the *Illustrations*, on which he worked for nineteen years. His name is preserved in its attachment by authors to a number of insects. His friend and contemporary Herman Strecker (1877) described him as "the most hard-working, overworked, indefatigable entomologist in all America, Prof. Townend Glover, the extent of whose labors in economic entomology are yet to be estimated at their true value." Another of Glover's labors is yet to be estimated -- his invention of the first light trap for insects.

II. The "American Moth Trap"

Movable lights (lanterns) were used by the English entomologist James Petiver to attract moths as early as 1695 (Wilkinson, 1966a). This method was continued in the eighteenth century. Kirby and Spence (1815-26), widely read in England and America, popularized the idea of placing a lamp inside a window to use an entire room as a 'trap' of sorts. Edward Doubleday (1837) collected Lepidoptera very successfully in America using a lighted barroom with open windows. Yet not until the 1860s did the idea of a portable self-contained light trap evolve. The "American Moth Trap", which spawned a host of devices culminating in the modern traps used with such success today, was first described in 1866 by the Englishman H. G. Knaggs, one of the editors of the *Entomologist's Monthly Magazine*.

When Townend Glover travelled to Europe in the summer of 1865 to attend the Paris exhibition, he also visited London (Glover, 1866). Knaggs explained in his paper that he had been introduced to "Mr. Glover of Washington, U.S., then on a visit to this country [England]." Although not identified as Townend, this was certainly he. Knaggs obtained "many novel and valuable hints on collecting" from Glover, but the thing that impressed him most was Glover's account of his "marvellous moth trap", an apparatus which in the inventor's words would "catch moths all night without any trouble to the owner" (Knaggs, 1866).

The trap was in the form of a box fitted with a kerosene lamp, panes of glass and a sliding drawer. Knaggs' cross-section of the trap and schematic diagram, along with his explanation of its construction, are shown as Fig. 1. To operate the trap, the glass slide O was removed and the lamp was lighted. An insect flying toward the lamp was diverted by the converging glass panes until it entered the aperture ZS. Once inside the trap it eventually found its way to the drawer. To examine the contents of the trap, the glass slide O was replaced and the drawer was withdrawn. Perhaps through Glover's advice, Knaggs suggested two sizes for the trap; a portable travelling one of about a cubic foot with a tripod, top



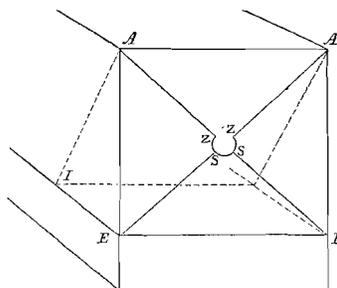
A B C D is a box, having a partition I F for lamp K to rest on, behind the latter being a strong reflector L. The box A B C D is open at A E, also at H G (for lamp chimney to pass through), and at F C for the drawer M.

M is a drawer fitted above with a glass slide O running in a groove; and a Venetian blind-like apparatus P P (the laths of which are kept in position by the side strips indicated by the dotted lines Q Q), dropping loosely on to the side-rests R R. It is also fitted with a small drawer N, the latter being filled with layers of flannel for the reception of chloroform, and stopped by the block Y.

A (Z) I is a quadrilateral sheet of glass, of the width of the box, fixed at the angle shown in the figure.

E S is another piece of glass of the shape of a triangle with the apex cut off.

A E S Z (represented by the lines A Z, E S and dotted lines A E, Z S) are two other bits of glass shaped like E S—the four pieces A I, A E S Z, E S, and A E S Z



(No. 2) being arranged and fixed (as shown in accessory perspective figure) in such a manner that, viewed from the point V, they form a hollow four-sided pyramid, the apex of which is wanting, as shown at Z S in both figures.*

T, V, and X are arrows indicating the direction an insect flying towards the lamp K must unavoidably take.

N.B.—Besides the above, it is recommended that the parts

of the sides of the box corresponding with the triangles A E I should be lined with glass; and a duplicate drawer, fitted up in every way exactly like the drawer M, should be prepared in readiness for use.

Fig. 1, Glover's moth trap, from Knaggs (1866).

handle and leather or cloth cover, for "working the rides of woods and other outdoor situations", and a second "adapted to fit the space left by the opened sash of a window". He noted that Lepidoptera would be the most frequent visitors to the trap, although other orders including the Coleoptera could be taken.

A great deal of thought was expended by Glover on his rather complicated trap, and undoubtedly prototypes had been constructed. American sources are silent about development of the design. It would be stretching the historical evidence (or lack of it) to suggest that the first USDA entomologist may have envisioned the trap to sample economic insects according to the same concept used by USDA scientists who are now working with the descendants of Glover's trap. In fact, nothing in the American literature indicates that Glover did anything further with the device himself.

When Knaggs published the first edition of his enormously popular *Lepidopterist's Guide* in 1869, he included a reference to his account of 1866, and anticipated the way in

which Glover's intricate trap would eventually be simplified, although Knaggs applied his principle to an entire room; "I may say that on the same principle [Glover's] a room may be readily fitted up . . . to the open space formed by raising the lower sash of a window, fit two glass frames (single pieces of glass if possible), slanting back into the room, and forming with one another an angle of 30° or so, that is, they would form that angle, but that they are to be kept about an inch and a half apart at their room end" (Knaggs, 1869). Knaggs' long aperture was a decided improvement upon Glover's four-sided funnel.

Despite Knaggs' hint, the first portable light traps actually to be constructed for sale seem to have been made according to Glover's specifications. Advertisements show that T. Cooke, the well-known dealer of naturalists' supplies in New Oxford Street, London, was selling the Glover trap in two sizes as early as 1869. These were purchased by a number of collectors, for by the spring of 1870 a lively discussion was taking place in the pages of Edward Newman's London journal *The Entomologist* about the merits of the "American Moth Trap".

One correspondent reported it a "complete failure". He had bought one from Cooke and had used it on favorable nights "without the slightest result" (Livingston, 1870). Another tried the trap "without the slightest success", but did not consider that the trap was at fault, and meant to try it under more favorable circumstances (Birchall, 1870). A third stated that "a more useless article has never been manufactured". He had tried it in numerous positions and numerous localities, but had taken few specimens; the apparatus was "so cumbersome that it requires two able-bodied workmen at least to carry it any distance, and the amount of oil it consumes is positively fabulous, and, I need hardly say, quite incommensurate with the value of the insects it obtains, even at the dearest dealers . . . I may mention that while these lumbering paraphernalia were looming in an adjacent coppice, I often succeeded in attracting many moths at a window of the house by the aid of an ordinary candle" (Bourne, 1870).

Bourne's tongue-in-cheek attitude was more humorous than most opinions of the "American Moth Trap", which was the target of every barb that could be designed by the characteristically querulous Victorian entomological fraternity. The trap caused a stir only in England, and the rather one-sided controversy did not spread to the American journals. Despite the many condemnations, Cooke continued to sell the Glover design, and Knaggs added an extended description and a figure of the trap to the second edition of his *Lepidopterist's Guide* (1871).

The fact that the trap was a new technique may have discouraged some traditional entomologists from giving it a fair trial, but there seems to have been an actual fault in the design, due to the angle at which the glass panes were placed. Several correspondents to *The Entomologist* called attention to this. Gregson (1870) noted that "however large the light within it might be, the rays therefrom were effectually locked inside by the angles of the glass in front being so near the angle of the light-rays; hence little light could be distributed, except from the small aperture by which the moths were expected to enter the trap." Gregson also advocated a simplification; if owners would "destroy the inverted glass front, and have a flat front glass put in rather over half-way up, and above this two or three strips of glass about an inch and a half wide, overlapping like an open Venetian blind," an improvement would be made. Gregson also advocated removing the drawer and replacing it with a handful of hay, grass or fern in which the moths could hide themselves.

In the 1880s another fault of the Glover trap was pointed out, that due to the design it was as easy for moths to escape as it was for them to enter the trap originally (Hall, 1886). This shortcoming was first remedied by Sabine (1886). In this decade collectors were still purchasing the American Moth Trap ready-made, or constructing it from the plans in Knaggs' ever-popular *Lepidopterist's Guide* (Samuels, 1886) and other sources (King, 1886). At least one positive feature of the manufactured traps was that they were constructed of metal instead of wood, and warping was prevented (Cooke, 1890).

One reason that the box-trap retained a certain degree of popularity and led entomologists to further experimentation was the realization that other factors than the design had caused a poor initial success. Those who had tried the increasingly popular method of "sugaring" for moths had found that such factors as humidity, temperature, moonlight and wind were very important in choosing nights for collecting (Wilkinson, 1966b), and these discoveries were adapted to light-trapping (Hall, 1886; Kimber, 1893; et

alia). Such early commentators on the Glover trap as Bourne (1870) had noticed that other artificial lights in the vicinity were a detrimental factor, and this was increasingly seen to be a major cause for the failure of trapping attempts (Beloe, 1886). By the mid-1880s, constructive communications on light traps were frequent in *The Entomologist*.

More modifications were eventually made to the original Glover design, which changed it into the simplified slanted-pane box trap used widely by the end of the century. The English "Christy trap" (Fig. 2) was simply the Knaggs (1869) adaptation of Glover's

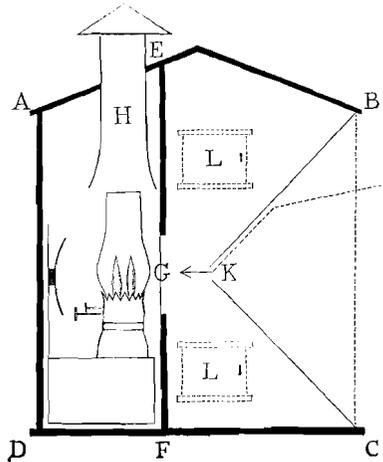


Fig. 2. Christy's moth trap, cross-section, from Christy (1890). EF is a partition, in which is a glass window. G, BK and CK are rectangular panes of glass. L,L are sliding panels for access to the trap. There is no drawer.

principle to a room, fitted by Christy (1890) to a trap. Christy did away with Glover's drawer and replaced the four-sided funnel by two panes of glass, thus substituting a long aperture for Glover's tiny entrance, and greatly increasing the productivity of the trap. Yet as late as 1892, traps on the original Glover design were still in use, for Christy (1892) mentions them as still being sold.

Studd (1893) further modified the trap to the familiar 'overhang' design (Fig. 3), more effective in preventing insect escape. The Christy and Studd modifications were discussed by Knaggs (1901) in the retitled third edition of his *Guide*. Knaggs noted that "the original arrangement of the glasses [i.e. Glover's] has been greatly improved upon", and collectors seem to have agreed, for the basic Studd modification of the Glover trap is well known to most older lepidopterists today, although electric bulbs and, more recently, fluorescent tubes (Wilkinson, 1969) have been substituted for the kerosene lamp used in the nineteenth century. Even the latter has survived, for in his guide to young amateurs, Brown (1968) includes a diagram of a portable Christy trap using a lantern as a light source.

Were the history continued, it would be seen that Townend Glover's original self-contained design has led to all of our present light traps. The Robinson device and the USDA omni-directional trap equally trace their ancestry to Glover's invention, for each successive step in the improvement of light traps was an improvement upon Glover's original design and its descendants.

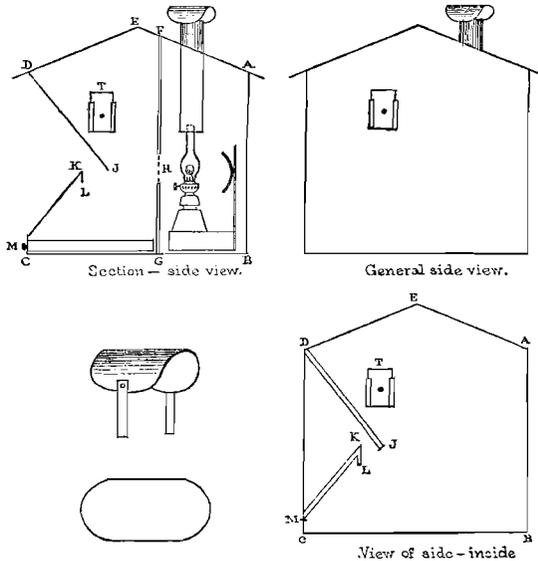


Fig. 3. Studd's moth trap, cross-section, from Studd (1893). The partition is similar to Christy's, and the drawer from Glover's design reappears in a simplified version. T is a sliding access panel.

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