

# About The Elytra When Insects Fly

Hyogo Prefecture Kobe High School Comprehensive Science Class 1-9

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## Introduction

While most insects which belong to *coleoptera* fly with their elytra up(Fig.1), some insects such as *Cetoniinae* and *Scarab beetle* fly without raising them(Fig.2). We wondered why this was so we decided to experiment.



Fig.1 Beetle Fig.2 Cetoniinae

## Hypothesis and Purpose

We thought species flying with their elytra closed escaped from enemies such as birds by improving their flying ability. Therefore, we hypothesized that the flight speed would be increased by closing the elytra and reducing air resistance. This experiment tested this hypothesis.

## Methods

We used *Protaetia orientalis submarumorea* kept under 27°C and compared the flight speeds of the 3 patterns.(we got them from the Internet.)

Normal···Add nothing to it

Down(Fig.1)···Put additional elytra on their elytra with them closed

Up(Fig.2)···Put additional elytra on their elytra with them raised

※We attached elytra by using a glue gun

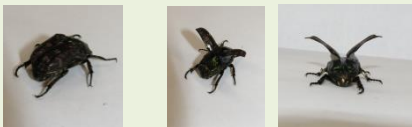


Fig.1 Down pattern Fig.2 Up pattern

The speed is measured by a device called a *flight mill* (Fig.3).

- Expose it to the warm air of 33 to 37 degrees and block the warm air when it starts to fly, and record for 30 seconds at 1/8x speed.

- Measure the time every 5 rotations

- Do the second measurement after about 1 hour has passed

- When flying, the bevel angle of the abdomen is 15 to 20 degrees in the horizontal direction(Fig,4)

- Use the maximum speed of the flight (we thought that it was released when escaping from enemies)

- Apart from the speed measurement, shoot from the side at 1/210x speed and compare to find whether the number of flapping changes with the above 3 patterns

※2a flight mill makes the individual do circular motion.



Fig.4 Seen from the side



Fig.3

## Result

As shown below, the amount of flapping has no relation to the maximum speed and the difference is small, so it seems that the conditions are equal(Fig.1).  
Fig.1

typeA	maximum speed	times(Ave.)	typeB	maximum speed	times(Ave.)
Normal①	233.7	X	Normal①	295.9	100.5
②	232.3	94.93	②	253.4	98.22
③	227.9	X	③	292.2	99.01
④	258.0	94.38	④	280.9	X
⑤	225.6	95.14	⑤	183.8	X
Up①	244.3	94.09	⑥	189.1	94.78
②	205.1	88.86	⑦	231.9	X
③	224.0	91.46	⑧	267.0	98.52
④	204.6	X	Up①	219.8	X
⑤	243.5	97.78	②	255.9	X
⑥	185.7	94.67	③	280.2	98.58
⑦	153.4	X	④	273.1	99.96
Down①	264.3	X	Down①	293.4	97.17
②	284.9	99.69	②	296.4	97.30
③	200.5	X	③	234.0	100.5
④	177.4	90.81	④	296.8	99.17
⑤	222.5	X	⑤	216.3	X
⑥	168.6	X			(cm/s)(times/sec)
⑦	190.0	X			
	(cm/s)(times/sec)				

※X=Data we couldn't get

Taking the time when it was particularly fast among the maximum speeds, the maximum speed of flight tends to be slower when flying with the elytra raised. On the other hand, there are exceptions, such as being slow without attaching anything, or being fast with an elytra.

## Consideration

Through this experiment, it can be inferred that one of the reasons for closing the elytra and flying is to increase the flight speed. In addition, this result may have been affected by the condition of *Cetoniinae* and the range of motion of flapping may have not been investigated well, and this value may not have been the limit of the maximum speed of *Cetoniinae*, so it is necessary to increase the amount of data.

## Future Prospect

We will establish a method for measuring the range of motion of flapping, compare flight times that were difficult to measure due to experiments in winter and investigate the improvement in flight efficiency by closing the elytra. In addition, the amount of data will be further increased to improve the credibility of the results. We also want to experiment with the other benefits of closing the elytra (such as being able to make sharp turns and reducing the amount of water vapor released from the body).

## References

Sato Kaichi: Flying ability of adult Longhorn beetle, *Nichibayashi Magazine* 87:247~250,2005

<https://www.youtube.com/watch?v=t8GzLFd8EnA>