

The

Aeroplane



英语科普注释读物

飞机

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陈 强 注释

上海译文出版社出版

(上海延安中路 967 号)

新华书店上海发行所发行

赣东北印刷厂印刷

开本 787×1092 1/32 印张 1.875 字数 36,000

1979 年 1 月第 1 版 1979 年 1 月第 1 次印刷

印数: 1—200,000 册

书 号: 9188·24 定 价: 0.16 元

注释者的话

本书选自英国科普丛书 How It Works 中的一个分册。原文是英国人 David Carey 撰写的。全书介绍飞机的飞行原理、性能和基本结构。

本书文字比较浅近，可供广大科技工作者以及中小学英语教师、英语或有关专业学生阅读。文中较难的句子结构、习惯用语和专业用词等都作了注释，以便读者借助注释，逐步提高对英语科技读物的阅读能力。

在注释过程中我们曾得到有关专业工作者的协助，在此表示感谢。由于注者的水平所限，注释中难免有缺点或错误，希望读者批评指正。

一九七八年九月

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The Aeroplane

Introduction

Of the three modes of travel, by land, water or air, air travel has always presented the greatest problem.¹ It is only in fairly recent years that man has been able to build a really reliable machine to transport him efficiently and safely in the air.² That machine is, of course, the aeroplane, and it is the purpose of this book to describe as simply as possible how and why an aeroplane works³.

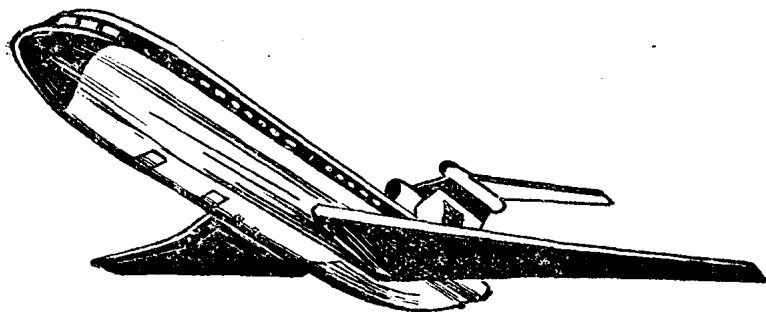
Motor cars travel on solid ground and have only to be propelled along. Boats and ships are supported by the water and will remain afloat under all normal conditions. But an aeroplane is heavier than the air in which it has to fly⁴, yet it must be got off the ground, made to stay in the air *in spite of*⁵ its weight and finally brought back to

1. 在陆地、水上、空中三种旅行方式中，空中旅行往往出现的问题最大。句首的介词 of 在这里作“在……中”解。by land, water or air: 从陆地、水上或空中。 2. 只是在较近的年代里，人类才能制造出一种真正可靠的机械装置来进行安全有效的空运。这是强调结构的句子，强调在较近年代里，而不是在其他时期。这种强调结构的句型是“it is (或 was) + 被强调部分 + that (who)...”。被强调的部分可以是主语、宾语、状语、宾语补足语等，如果被强调部分是人，则用 who (或 that)，其他一般用 that (或有时用 which)。 3. 尽可能简单地叙述飞机怎样飞行以及为什么会飞行。注意 as... as possible (尽可能地...)的用法。如: as soon as possible: 尽快地，as economically as possible: 尽可能节约地。how and why... works 是 to describe 的宾语从句。 4. 飞机比它必然要在其中飞行的空气要重。in which... fly 是定语从句，修饰名词 air。 5. 尽管。

earth gently without damage.

To discover how an aeroplane works, we must first *find out*⁶ about the air itself, how it behaves and how it affects an object moving through it. *The way an aeroplane is built to make use of the air is important, as is also the method by which it is controlled and made to obey the wishes of the pilot.*⁷

It is a big subject but a truly fascinating one.



6. 弄清楚. 7. 如何制造飞机使之利用空气是重要的, 如何操纵飞机、并使
之顺从驾驶员的意愿也是重要的. 在 *the way* 后面, 习惯上可省略关系副词
that 或“介词 *in* + 关系代词 *which*”. *to make use of*: 利用. 句中的 *as is*
also the method... 相当于 *the method... is also important*, 这里的连词 *as*
作“象……一样”解, 引出从句时主谓语序颠倒. 这种用法可避免表语或谓
动词的重复. 如: *We supported the resolution, as did all the students in*
other classes. (我们赞成这项决议, 其他班的同学也是如此.)

The air

There is a *huge envelope of air*¹ around the surface of the earth. This air has an *atmospheric pressure*² *due to*³ the weight of all the air above it. As we leave the earth's surface and go higher, the pressure becomes less because there is less air above to press down. *At sea level*⁴ the air pressure is nearly fifteen pounds on every square inch of surface; at twenty thousand feet this reduces to seven pounds to the square inch; at sixty thousand feet the air pressure is only one pound per square inch.

*Air is also compressible, which means that it is more compressed, or denser nearer the ground.*⁵ Once again, this is *because of*⁶ the pressure of all the air above. Because it is more dense, air at sea level is heavier than the air higher up. If we use the same height examples as before, we find that one hundred cubic feet of air weighs nearly eight pounds at sea level, only four pounds at twenty thousand feet and less than *three-quarters of a pound*⁷ at sixty thousand feet.

These differences of air pressure and density *have a*

1. 大气层。 2. 大气压力。 3. 由于。 短语介词。 后面可跟名词，代词或动名词等。 4. 在海平面。 5. 空气也是可压缩的。 这意味着，越近地面，空气越受压缩，也就是说其密度就越大。 *which... ground* 是非限制性定语从句，关系代词 *which* 指主句全句的意思。 *nearer* 是副词，是 *near* 的比较级，后面省略介词 *to*。 6. 因为。 短语介词。 7. 四分之三磅。

very great bearing on⁸ the design of aeroplanes, a fact you will be able to understand better as you read further into this book.

PRESSURE



AT 60,000 FEET

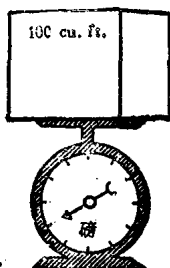
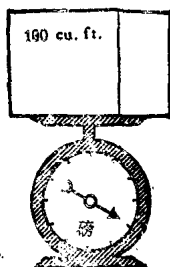
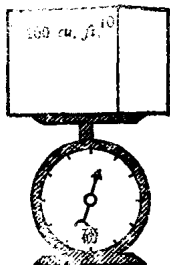


AT 20,000 FEET



AT SEA LEVEL

WRIGHT



8. 对……关系极大。 9. SQ 系 square 的缩写词。square inch 平方英寸。
10. cu. 和 ft. 这里分别是 cubic 和 feet (有时为 foot) 的缩写词，作立方英尺解。

Lift and drag

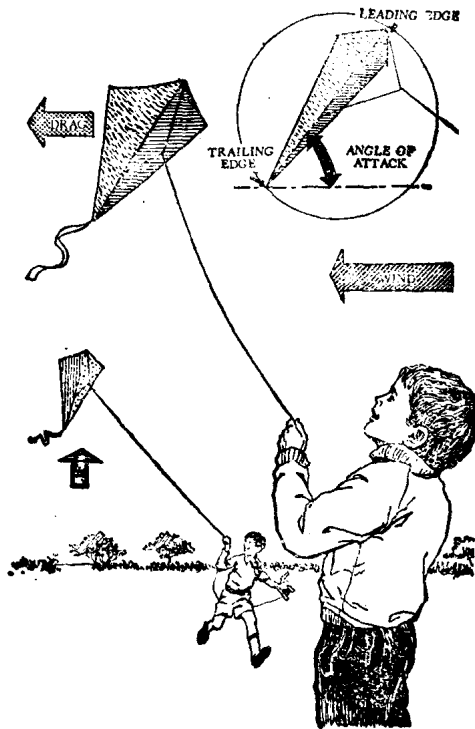
To enable an aeroplane to fly in the air it must be given a lifting force at least equal to its own weight¹. How is this lift to be provided?² Let us first consider a more simple flying object—a kite. The strings of a kite are so fitted that when the kite is flown it is not flat or upright but inclined at an angle, the front or leading edge being higher than the rear or trailing edge.³ Have you ever noticed this? The angle at which the kite is inclined is known as the angle of attack.⁴

As you give the kite speed by holding the string and running, it will rise into the air and if you pay out⁵ the string it will rise higher and higher. The upward force⁶ which makes the kite rise is called the lift. If you grip the string tightly and draw the kite toward you in the air, you will feel a pull as the air tries to hold it back⁷. This

1. 至少和飞机本身重量相等的升力. at least equal ... weight 是形容词短语作后置定语, 修饰 a lifting force. 2. 这个升力是如何产生的呢? 注意: 句中的谓语动词是 is + 被动结构的动词不定式 to be provided, 在这里其意义相当于 can be provided. 3. 安接风筝线, 要使风筝在放出后, 既不是平躺的又不是直立的, 而要成一个倾斜角, 前部或前缘比后部或后缘为高. so ... that ... : 如此……以致……. when ... flown 是 that 引导的结果状语从句中的时间状语从句. the front ... or trailing edge 是“名词+分词”的分词独立结构, 在句中作状语, 表示陪衬动作. 4. 风筝倾斜构成的角称为攻角. to be known as ... : 被称为……. 5. 放(线). 6. 向上力. 7. 这里作“往后拉”、“拖住”解.

pull is known as drag and it acts against the direction of flight.

With^s aeroplanes, lift is a useful force which is essential to flight. It is obtained partly by the wings and partly by the aeroplane's forward speed. Drag is a backward pull which hinders forward motion and has to be reduced to a minimum.



8. 就……来说.

Aeroplane wings

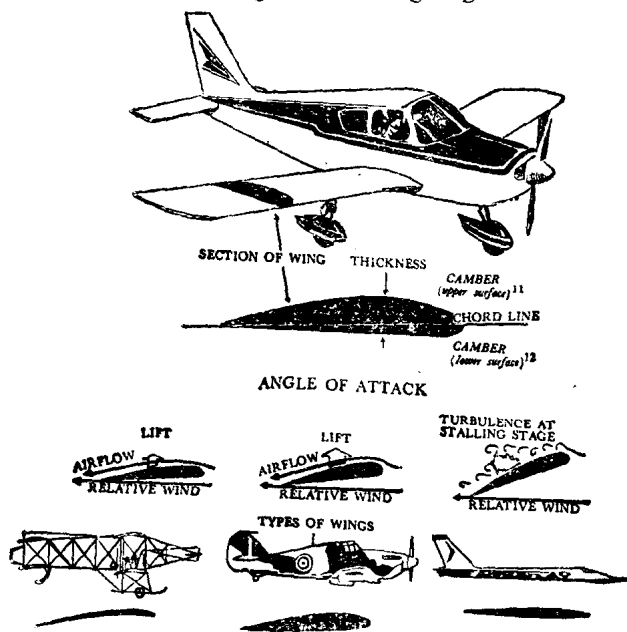
So far¹ we have been dealing with² the simplest form of wing—the kite—with its flat surfaces and light weight. Aeroplanes need something much more efficient, and designers have developed wings of special, curved shape known as aerofoils. An aerofoil is really made up of³ two surfaces, an upper and a lower, each with a different curve or camber. There are two main reasons for this: firstly, a curved surface gives better lift, and secondly, an aeroplane wing has to get a heavy machine off the ground, so it must have thickness into which the necessary strength can be built⁴.

In the previous chapter we mentioned the angle at which the kite was inclined upward, that is⁵, the angle of attack. Aeroplane wings also have an angle of attack and are fitted to the fuselage with the leading edge slightly higher than the trailing edge when seen in the flying position.⁶ An increased angle of attack gives more lift, as with the kite, but also increases the drag.⁷ For normal flight the angle of attack has

1. 迄今为止。 2. 论述。 3. 由……组成。 4. 所以机翼必须具有厚度，才能使它具有必要的强度。 into which ... built 是定语从句，修饰 thickness。 5. 那就是。 插入语。 6. 机翼也有攻角，从飞行时的位置来看，装在机身上的机翼，其前缘要比后缘稍高些。在 when seen ... position 的从句中，主语和助动词 they are 省略，they 指 aeroplane wings。一般说来，从句中省略的主语应该和主句中的主语相一致。 7. 如同风筝一样，攻角增大，升力增大，阻力也增大。注意：在“连词 as+介词短语”这种结构中，主语、谓语动词习惯省略，这里 as 所引导的从句在句中作状语，表示状态。

to be just right to ensure sufficient lift and at the same time cause as little drag as possible.

On modern fast-flying aeroplanes the angle of attack is very small, usually not much more than about two degrees from the horizontal when in level flight.⁸ The angle of attack is the angle between the relative airflow⁹ and the chord line¹⁰. The chord line is the line joining the centres of curvature of the leading and trailing edges.



6. 现代快速飞机的攻角非常小，当飞机在水平飞行时，和水平线构成的攻角通常不超过两度。在 when ... flight 的从句中，主语和谓语动词 they are 省略，they 指 modern fast-flying aeroplanes。注意：在本句中，从句所省略的主语和主句中的主语并不一致，这种用法在现代科技英语中时有出现，只要上下文清楚，不影响含义，是允许的。 9. 相对气流。 10. 弦线。 11. 上弧线、上曲面。 12. 下弧线、下曲面。

Airflow over an aeroplane's wing

For an aeroplane's wing to give the lift required for flight, the general airflow over and around the wing must be streamlined and not turbulent.¹

The amount of lift the wings give will depend on²:

1. Their shape.
2. Their area.
3. The density of the air through which they fly.
4. The speed at which the air passes over them.
5. The angle of attack.

Numbers 4 and 5 are the ones which can be controlled by the pilot, although he has some control over number 3 by choosing the height at which he flies.

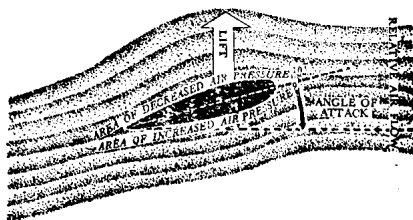
For a given speed, the amount of lift is controlled by the angle of attack, *the greater the angle of attack—the greater the lift*³. This is true up to the angle of attack known as *the stalling angle*⁴, when the general airflow becomes turbulent and there is a sudden decrease in the amount of lift.

As the weight of a plane in the air is constant, the lift

1. 为了使机翼产生飞行所需的升力，流经机翼及机翼周围的全部气流必须是流线的，而不是涡流的。 2. 取决于。 3. 攻角越大，升力就越大。“the + 形容词(或副词)比较级…， the + 形容词(或副词)比较级…”作“越…，就越…”解，一般说来，前面的 the 是关系副词，引导从句，后面的 the 是指示副词，引导主句。主句、从句都可省略某些成分。本句中的主句、从句都省略了谓语动词 is。 4. 失速攻角。

required to keep it flying straight and level⁵ must also be constant. Because of this, a test pilot⁶ can, at a safe height, fly straight and level, gradually reducing his speed but increasing his angle of attack so that the lift remains constant⁷, until the stalling angle is reached. In straight and level flight, the stalling angle will always be reached at the same indicated airspeed, which is known as the stalling speed⁸.

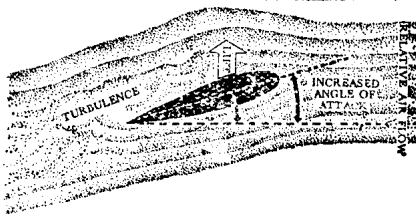
STREAMLINED AIRFLOW PAST A WING IN SLOW FLIGHT



The airflow remains streamlined until the stalling angle is reached, when the airflow quite suddenly becomes turbulent, resulting in a sudden decrease in lift¹¹.

Any attempt to increase further the angle of attack will result in even more loss of lift.

TURBULENT AIRFLOW PAST A WING AT STALLING ANGLE.



5. 使飞机保持直线水平飞行. flying straight and level 是分词短语, 作宾语 it 的补足语. 6. 试飞行员. 7. 逐步减速, 但增大攻角, 使升力保持不变. so that... (使得...), (为的是...), 引导目的状语从句. 8. 失速速度. 9. 增压区. 10. 减压区. 11. 形成升力突然减少. to result in...: 导致..., 终于造成...结果.

Forces acting on an aeroplane

We can now *sum up*¹ the various forces which *act on*² an aeroplane and see how they affect the whole machine in straight and level flight.

An aeroplane gains almost all its lift from the wings, *the remaining parts*³ help very little. *On the other hand it is the body, or fuselage, engine mountings and other protruding portions which cause most of the drag.*⁴ We must therefore *have all these parts as smooth and streamlined as possible*⁵. A dart will fly better than a ball because it creates less drag, so this is the sort of shape aircraft designers must try to achieve.

Lift on an aeroplane acts vertically upward, the machine's weight pushes vertically downward. To fly straight and level, the lift must equal the weight. *If the lift were greater the aeroplane would go higher and higher. If the weight were greater the machine would get lower and lower until it hit the ground.*⁶

1. 总结. 2. 作用于. 3. 其他部件. 4. 另一方面, 产生大部分阻力的却是机身、发动机架以及其他突出部分. 这里的 *which* 相当于 *that*. (参见第2页注2) *on the other hand*: 另一方面. 5. 使所有这些部件尽可能平滑和成流线型. 这里的谓语动词 *have* 作“使”解. 6. 如果升力较大, 飞机就会越飞越高. 如果重力较大, 飞机就会越飞越低, 直到触及地面. 这两句句中的谓语动词都是虚拟形式. 在表示一般情况时, 从句中的谓语动词用相当陈述语气过去时的动词形式, 主句中的谓语动词用“*would + 动词原形*”, 来表示假设.