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总 主 编: 张亚非

副总主编: 陆树明 李公昭 本册主编: 赵艳芳 张瑞花

副 主 编: 牟善成 吴永淑 于运山 单学英 编 者: 王丽君 陈 静 吴倩雯 陈媛媛

胡雪乔 宋翊宁 王金彪 彭耘珠

审 校:张亚非

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20 世纪末,为加快陆军现代化建设步伐,走有中国特色的精兵之路,在中国人民解放军减员 50 万、军队院校精简四分之一的情况下,中央军委决定组建陆军航空兵学院。经过几年的发展,陆军航空兵学院已成为政治与军事、指挥与技术、空勤与地勤、军官与士兵合训的一所中级任职教育院校,是中国人民解放军乃至全国唯一专门培养直升机专业人才的院校。学院主要承担陆军、空军、和武装警察部队直升机飞行员、陆军航空兵营、团级指挥和参谋军官,航空机务干部、士官的培训任务。作为陆军航空兵唯一一所院校、学院还担负着陆航军事理论和装备发展等研究任务。

随着科学技术的日新月异,科学成果不断被应用到军事领域,一场新的军事变革正在全球蓬勃兴起。作为我军的重要兵种之一的陆军航空兵,在军队发展战略和安全战略中的独特地位和重大使命也日益突显。为适应国防现代化的需要和陆航建设的需要,培养高素质复合型军事人才和工程技术人才,提高和加强相关人员的外语素质是非常重要的。用英语作为工具,了解和掌握直升机的知识和技术,将英语和专业知识相结合,提高综合素质和任职能力,是当前我军教改的大方向,也是满足未来陆航第一任职的需要。为此,我们编写了这本《直升机及陆航英语》教材。

本教材内容选自国外有关直升机的英语书刊杂志,外军网络及公开发表的资料,覆盖了直升机的发展、构造、飞行原理、直升机维护及飞行安全、飞行理论、外军陆航的发展等方面,语言流畅,规范,难度适中,适用于直升机飞行学员、发动机工程及维修学员作为专业英语教材使用,也可以作为具有一定英语水平的陆航空勤、地勤及指挥人员自学教材。本教材包括 20 个单元,每单元提供一篇 1000~1500 字的文章,配有军事及技术术语、生词表、注释、任务型应用练习及全文翻译,目的是使学习者掌握一定的专业英语词汇和表达方法,掌握相关军事知识,培养军语运用能力,提高阅读能力,并通过阅读相关专业英语文章,翻译英语资料,吸收新知识和新信息,提高业务任职能力,也为口头交流打下一定的基础。

本教材在编写过程中得到了学院和基础部领导的大力支持,计算机教研室王金彪负责插图和版面的技术设计,相关教研室的很多同志也帮助审阅译文,提出了宝贵意见,在此表示衷心的谢意。由于水平有限,书中难免有疏漏和错误,特别是术语的表达可能还不够贴切,望读者批评指正。

编 者 2009 年 8 月于北京

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Part One

Development and Technology of Helicopters

Lesson 1

Early Ideas about Helicopters

Military and Technical Terms in the Text

helicopter 直升机
rotor blades 桨叶
aeronautics 航空学
torque reaction 扭矩
fuselage 机身
autogyro 旋翼飞机
the Royal Air Force 英国皇家空军部队

prototype 原型
autorotation 自动旋转
biplane 双翼飞机
hover 悬停
outrigger 外架
tail rotor 尾桨

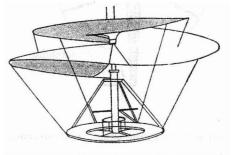
Text

Early Ideas about Helicopters

The helicopter is not such a modern invention as many people think. As long time ago as

the year 1490 one of the greatest inventors the world has ever known, Leonardo da Vince^①, drew plans for a flying machine, which was to **screw** itself **vertically** up into the air by means of^② a rotating **spiral vane**.

Long before this, there are records of an ancient Chinese toy with which children used to play. It was made of cork and bamboo, with feath-



ers for the "rotor blades", and could be spun to fly like a bird. A somewhat similar toy was made by two Frenchmen, Launoy and Bienvenu, in 1784, and was demonstrated to the French Academy of Sciences³, where its performance created quite a sensation⁴.

About sixty years later, Sir George Cayley, who is known as the "Father of British Aero-

① Leonardo da Vinci:雷奥纳多・达・芬奇

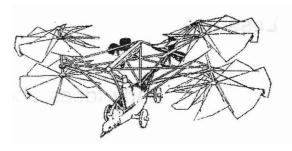
② by means of:通过;用;借助于

③ French Academy of Sciences:法国科学院

④ create quite a sensation:引起相当大的轰动

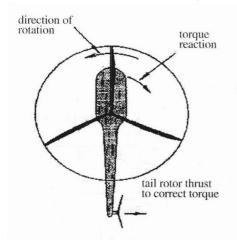
nautics", designed a rotating wing aircraft which resembled a duck in shape and was to be lifted by two pairs of eight-bladed rotors driven by a steam engine. Equally fantastic designs were proposed by other inventors from that time right up to the early 1900's.

①What is not clear from da Vinci's sketch is how he intended to counteract what is known as torque reaction. This tech-



Sir George Cayley's rotating wing project(1843)

nical term is easy to understand, because, when an engine drives any rotating mechanism, the engine itself always tends to turn, with its mounting, in the opposite direction to that mechanism which is being driven. A good example is an electric **drill**. ②When it is held in the hand and switched on^①, a force can be felt which tends to turn the body of the drill in the opposite direction to that in which the **armature** of the motor is spinning. This force is called torque reaction.



In the case of[®] the helicopter, where the engine is mounted in the **fuselage** to the rotor, if nothing were done to stop it, the torque reaction would cause the fuselage to spin round in the opposite direction to the rotor whilst the machine was in flight. Obviously, the pilot could not fly the helicopter if this happened, and the various methods employed by engineers to overcome torque reaction are responsible to a large extent for the wide variety of different helicopter designs which can be seen today.

30f all the inventors whose names are associ-

ated with ortating wings, two are outstanding. One was Juan de la Cierva, a Spanish engineer who, in 1923, developed the first successful autogyro. This was the first type of rotating wing aircraft to be developed beyond the prototype stage, and many were flown by private owners and the Royal Air Force before 1939. The other inventor was Igor Sikorsky, who was among the pioneers of helicopter construction in Europe as early as 1909. Later, he became famous as

① switch on:开

② in the case of:就…来说,关于

③ to a large extent:很大程度上

④ be responsible for:对…负责

⑤ be associated with:与…发生联系,与…相提并论

a designer of fixed-wing aircraft and the company he founded is now one of the leading helicopter constructors in the United States of America.

Cierva's contribution to rotating wing science was to pave the way for practical helicopters by solving, with his autogyros, all the basic aerodynamic problems of rotating wing system. The inability to fly safely at very low speeds was, and still is, one of the most serious disadvantages of the fixed-wing aeroplane. Cierva's aim was to design a safe flying machine which would not stall and crash when its speed through the air was reduced to zero. The achieved his objective by discovering the principle of "autorotation", which is still the foundation upon which all helicopter flight depends.

Earlier inventors had assumed that, to develop "lift", the rotors had to be power-driven with the blades set at a high angle of pitch, or twist. The only non-power-driven rotor which was known at that time was the windmill, the blades of which were set at a negative angle of pitch and could not develop lift.

Cierva's basic discovery was that between these two extremes there was a small positive angle of pitch at which the blades could be set to ensure that the rotor would continue to rotate automatically in an airstream, without an engineer to drive it, and develop enough lift for sustained flight. He termed this phenomenon 'autorotation'. At this angle, the blades would not begin revolving in the airstream of their own accord, like windmill blades. They had to be set in motion[®] by some mechanical means. But once started, rotation continued automatically at a constant speed provided a continuous airstream was kept flowing through the rotor.

For his first experiments, in the early 1920's, Cierva used a small fixed-winging biplane, to which he attached a single rotor mounted on a pylon above the fuselage in place of the upper wing. The pitch, or twist, of the blades was set by a small fixed positive angle of approximately 2 degrees. To start the rotor, a rope was wound round the rotor shaft and pulled by a number of willing helpers. The pilot then opened the throttle and the machine ran across the aerodrome to take off into wind, just like a fixed-wing aeroplane. The forward movement of the machine started an air stream flowing through the rotor, which kept the blades rotating. As forward speed across the aerodrome increased, the rotor began to develop lift and the autogiro became airborne.

Since the rotor system was not power-driven, it was not complicated by problems of torque reaction. Consequently, the autogyro was far simpler than earlier helicopter designs, and this contributed greatly to its success.

The main advantage of the autogyro was that it would not stall when flying speed was reduced. It would just lose height slowly, because the rotor continued to rotate and develop lift

① pave the way for:为…铺平道路

② set in motion:开动

irrespective of the machine's forward speed. When the airspeed was reduced to zero, the machine descended vertically like a **parachute** with the rotor still autorotating. SIn this case, the flow of air up through the rotor had the same effect of keeping the blades revolving as did the airstream when the machine was being pulled through the air in level flight by the propeller.

The autogyro rotor developed enough lift to maintain height at forward speeds as slowly as 25 m. p. h. but, because its rotor was not power-driven, it had one big disadvantage. It could not hover motionless in the air at a constant height as can a helicopter.

Sikorsky's contribution to rotating wing progress was quite different from Cierva's, but by no means[®] less important. As the basic theory of rotating wing aerodynamics became more widely known in the early 1930's, many fresh attempts were made to build helicopters. To mention only a few of the inventors, there was Breguet in France (1936), Focke in Germany (937), and Weir in Britain (1938). All built machines which were capable of hovering flight. But they all suffered from[®] one apparently **insurmountable handicap**.

To overcome torque reaction from the power-driven rotor, and so prevent the fuselage from spinning, their designers had been forced to use two rotors of equal size revolving in opposite directions so that the torques balanced each other. The Breguet helicopter had the two rotors placed co-axially, one above the other. The other two machines carried the rotors side-by-side on outriggers from the fuselage.

⑥It was Sikorsky who first proved it possible to design a helicopter with a single lifting rotor as in Cierva's autogyros. The torque reaction was balanced by means of a small vertical tail rotor, which exerted a side thrust at the end of the tail boom. With only one main rotor, the mechanical transmission was less complicated than in earlier multi-rotor arrangements and the machine he built in1939 to demonstrate this principle, the VS-300, was so successful that it put all previous helicopters completely in the shade. It was recognized that here, at least, was a design capable of being developed into a practical vehicle. The age of the helicopter had arrived.

New Words

机,直升机 screw/skru:/ vi. 转动,旋,拧 vertically/'və:tikəlli/adv. 垂直地 spiral /'spaiərəl/ adj. 螺旋形的 vane/vein/ n. (风车、螺旋桨等的) 翼,叶片 rotor /'rəutə/ n. (百升机的)水平

① irrespective of:不顾…的;不考虑…的;不论…的

② by no means: 决不,一点也不

③ suffer from:遭受,经历

④ put... in the shade:使某人或某事相形见绌,使…黯然失色

旋翼

blade /bleid/ n. 桨叶:(推进器的)翼 spin /spin/ v. 旋转, aeronautics / ¡ɛərə'nɔɪtiks/n. 航空学 torque/tolk/n. 扭矩, 转矩 drill /dril/n. 钻孔机, 钻子 armature/'aːmətjuə/n. (电动 机、发电 机的)转子;电枢 fuselage /'fjurzilarg/n. 飞机机身; 机舱 autogyro /ˌɔɪtəʊ'dʒaiərəʊ/n. 旋翼 飞机 prototype /'proutotaip/n. 原型 aerodynamic /¡ɛərəudai'næmik/adj. 空 气动力学的 stall /stɔːl/vi. (飞机)失速,使失速 autorotation / p:təʊrəʊ' teiʃən/n. 自动 旋转, 自转; 自旋下降 windmill / windmil/n. 风车

negative /'negətiv/adj. 否定的,消极

的,负的,阴性的

ensure /in'suə/v. 确保, 确保, 保证 accord /ə'kəɪd/n. 一致,符合,调和, 协定 biplane /'baiplein/ n. 双翼飞机,复 翼飞机 shaft / faxft/n. 轴, 杆状物 throttle /'θrɔtl/n. 节流阀;节流圈; 风门 aerodrome /'sərədrəum/n. 飞机场, 机场 airborne /'səbəɪn/adj. 空运的, 空气 传播的,空降的 parachute /'pærəʃuɪt/n. 降落伞 propeller /prə'pelə/n. 螺旋桨;推进器 hover /'həvə/v. 盘旋 insurmountable / insə'mauntəbl/adj. 不能克服的,不能超越的 handicap /'hændikæp/n. 障碍, 阻碍, outrigger / 'autrigə/n.【航空】(支撑机 翼用的)外架

Notes

①What is not clear from da Vinci's sketch is how he intended to counteract what is known as torque reaction.

- (1) 本句有两个由"what"引导的从句,第一个是主语从句,第二个是宾语从句。
 - (2) 本句"how"引导的从句为表语从句。

[译文]达·芬奇的草图中有一个问题尚不清楚,就是他是如何克服所谓"扭矩"的。

When it is held in the hand and switched on, a force can be felt which tends to turn the body of the drill in the opposite direction to that in which the armature of the motor is spinning.

本句有两个"which"引导的限制性定语从句,第一个"which"修饰"a force";第二个"which"修饰"that",指钻头转动的方向。

[译文]当你手持电钻打开开关时,你会感到一种使电钻把朝着与钻头转动方向相反的方向转动的力。

③Of all the inventors whose names are associated with rotating wings, two are outstanding. "of all..."是一个介词短语,表示"在所有的…当中"。

[译文]与旋转翼相提并论的所有发明家中,有两位十分突出。

4He achieved his objective by discovering the principle of "autorotation", which is still the foundation upon which all helicopter flight depends.

本句第一个"which"引导非限制性定语从句,修饰"the principle of 'autorotation'";第二个"upon which"引导限制性定语从句修饰"the foundation"。

[译文]他实现了他的目标,他所发明的"自动旋转"原理仍然是所有直升机 飞行的主要理论基础。

⑤In this case, the flow of air up through the rotor had the same effect of keeping the blades revolving as did the airstream when the machine was being pulled through the air in level flight by the propeller.

"as did the airstream"中的"as"引导一个关系从句,相当于 that,用于 the same, such 之后,指代 effect,表示"…亦如此,也一样",这是一倒装结构,正常的语序为"as the airstream did"。

[译文]此时向上流过旋翼的气流和飞机平飞时的气流一样都可以保持桨叶不停旋转。

- ⑥It was Sikorsky who first proved it possible to design a helicopter with a single lifting rotor as in Cierva's autogyros.
 - (1)本句为强调句式,强调主语,其结构为"It is(was)...that(who)"。
 - (2)从句中的"it"为形式宾语,真正的宾语为跟随其后的不定式短语。

[译文]西科斯基第一个证明了设计一架类似西瓦的自动旋翼飞机的单旋翼 直升机的可行性。

Topics for Discussion

- 1. What is a helicopter?
- 2. What is torque reaction? What will happen if we don't counteract it?
- 3. What was Cierva's contribution to rotating wing science?
- 4. What was Sikorsky's contribution to rotating wing progress?
- 5. How did later designers do to overcome torque reaction?
- 6. Why did so many people design and develop helicopters? Give your reasons.

Task-based Use of English in Military Studies

How to Use Dictionaries

It is helpful for you to own a dictionary when you want to learn English. When you have doubts about the pronunciation, spelling and meaning of a word, you should look it up in a dictionary.

The pronunciation of a word is shown in International Phonetic Symbols in many dictionaries. A dictionary entry shows the parts of speech of a word, the transitive or intransitive use of a verb, the plural form of an irregular noun, and other forms a word may have. The history of

a word is given in some bigger dictionaries.

The definitions, together with examples or illustrations, usage labels and notes are also given in a dictionary. You should study the definitions given in English instead of depending on Chinese translations for the understanding of the exact meaning of an English word.

The Task

Look up the new words in an English-English dictionary and learn their English definitions.

课文参考译文

直升机的早期构想

许多人认为直升机是一项现代发明,其实不然。早在 1490 年,世界著名发明家之一,意大利人雷奥纳多·达·芬奇就设计了一架通过旋转的螺旋叶片使其自身垂直升空的飞行器。

此前曾有孩子们经常玩的一种古老的中国玩具的记载。这种玩具是由软木和竹子制作,用羽毛做"桨叶",转动时可以像鸟一样飞行。1784年,法国人洛内(Launoy)和比沃努(Bienvenu)制作了一件类似的模型,在法国科学院进行了展示,其表演引起了轰动。

大约六十年后,被誉为"英国航空学之父"的乔治·凯勒爵士设计了一架旋翼飞行器,它的外形像一只鸭子,由一台蒸汽发动机驱动的两副八片桨叶的旋翼产生升力。此后直到20世纪初,其他发明家也提出了一些同样奇妙的设计。

达·芬奇的草图中有一个问题尚不清楚,就是他是如何克服所谓"扭矩"的。"扭矩"这个术语不难理解:当一台发动机驱动任何转动的机械装置时,发动机自身连同其座架也会转动,方向与被驱动的机械装置转动的方向相反。电钻就是一个典型的例子,当你手持电钻打开开关时,你会感到一种使电钻把朝着与钻头转动方向相反的方向转动的力,这种力叫做扭矩。

就直升机而言,发动机固定在机体上驱动旋翼,如果不设法克服扭矩,飞行中将导致 机体与旋翼旋转方向相反的方向转动。显然,这种情况一旦发生,飞行员将无法驾驶直 升机。我们今天见到的各种直升机设计样式正是工程师们采用了不同方案克服扭矩的 结果。

与旋转翼相提并论的所有发明家中,有两位十分突出。一位是西班牙工程师琼·戴·拉·西瓦,1923 年他成功地制造了第一架自动旋翼飞机,这是超越样机阶段的第一类旋翼飞机。1939 年前,一些西班牙私人拥有者和西班牙皇家空军曾多次驾驶这种机型。另一位发明家是美籍俄罗斯人伊葛尔·西科斯基,早在1909 年,他已经是欧洲直升机制造业的先驱之一了。后来,他成为一位著名的固定翼飞机设计师,他创建的公司目前仍是美国直升机制造业的龙头企业之一。

西班牙工程师西瓦对旋翼科学的贡献在于他用自动旋翼飞机解决了旋翼系统空气动力学所有的基本问题,从而为解决制造实用直升机铺平了道路。低速安全飞行问题过去是——现在仍然是——固定翼飞机最严重的缺陷之一。因此,西瓦打算设计一架在空中速度减小到零也不会失速坠毁的飞机。他实现了他的目标,他所发明的"自动旋转"原理仍然是所有直升机飞行的主要理论基础。

更早期的发明家曾设想,要产生"升力",旋翼必须有动力驱动,桨叶必须与水平面成高迎角,或者在轴向上向上扭转。那时,人们所熟悉的唯一非动力的旋翼是风车,风车叶片的迎角是"负"的,所以不产生升力。

西瓦的重大发现是:在上述两种极端情况之间,可以采取把桨叶安装为"正"小迎角,以保证在没有发动机驱动的情况下旋翼在气流中持续自动旋转,并且提供足够的升力来维持飞行。他把这种现象称为"自动旋转"。处于这个角度时,像风车的叶片一样,桨叶无法在气流中自己开始转动,必须借助某种机械方法来使其启动。桨叶一旦开始转动,连续气流将不断流过旋翼,旋翼将自动持续地匀速旋转。

20 世纪 20 年代初,西瓦用一架小型固定双翼机做了首次实验,他把一个单旋翼固定在机身的塔座上,桨叶的迎角固定为大约"正"2 度。用一根绳子缠在旋翼轴上,由人们拉动绳子转动旋翼,飞行员随后开启油门,实验机像固定翼飞机一样滑过跑道,迎风起飞。飞机向前运动产生流过旋翼的气流使旋翼持续旋转。随着飞机滑行速度的增加,旋翼产生升力,自动旋翼飞机升空。

自动旋翼飞机的旋翼系统为非动力驱动,所以不会受扭矩问题所困,它比早期直升机设计简单得多,这大大保证了实验的成功。

自动旋翼飞机的主要优点是当飞行速度变慢时不会失速,因为不管飞机的飞行速度 快慢,旋翼都能够持续旋转从而产生升力,因此飞机只会缓慢地降低高度。当飞行速度 降低为零时,飞机像降落伞一样下降,旋翼仍不停地自动旋转,因为此时向上流过旋翼的 气流和飞机平飞时的气流一样都可以保持桨叶不停旋转。

飞机平飞速度降至 25 英里/小时时,自动旋翼飞机的旋翼仍可提供足够的升力维持高度。然而,由于旋翼是非动力驱动的,这种飞机有一个较大的缺陷,它不能像直升机那样在空中悬停。

西科斯基对旋翼发展的贡献与西瓦有很大的不同,但绝非不重要。30 年代初期,随着对西瓦发现的旋翼空气动力学基本理论的更广泛的了解和掌握,人们多次尝试制造直升机,其中值得一提的是 1936 年法国的勃兰葛特制造的直升机,1937 年德国的福斯克制造的直升机和 1938 年英国的韦赫制造的直升机。他们的直升机具备悬停能力,但都有一个明显却难以克服的问题。

为了克服动力驱动旋翼产生的扭矩,阻止机身打转,设计者们不得不采用两个大小相同、旋转方向相反的旋翼来抵消扭矩。勃兰葛特直升机将两个旋翼安装在同一轴上,一个在另一个上面。另外两架飞机采用在机身外挂支架上并列安装旋翼的方式,这样虽然达到了控制机身的效果,却导致机械传动系统复杂化。因此,这些飞机都相当笨重且运载能力差。

西科斯基第一个证明了设计一架类似西瓦的自动旋翼飞机的单旋翼直升机的可行

性。扭矩可以通过一个垂直装在尾梁末端的小尾桨产生的侧向推力加以平衡。由于只有一个主旋翼,机械传动机构比早期的多旋翼结构简单得多。1939 年他制造的 VS - 300 飞机证实了该原理, VS - 300 的成功使所有之前的直升机黯然失色。人们认识到这正是一种能够发展成为实用飞机的设计。直升机时代来临了。

Lesson 2

The Evolution of Helicopters

Military and Technical Terms in the Text

swashplate 倾斜器
cyclic pitch control 周期变矩杆
vertical take-off and landing 垂直起落
flight performance 飞行性能
service life 使用寿命
take-off weight 起飞重量
cruise 巡航
maneuver ability 机动能力
rescue 救援

liaise 联络
Skylark 法国"云雀"直升机
Soviet M-1 苏米-1 直升机
transport aircraft 运输机
aircraft guns 舰炮
command 指挥
payload 负载
armed helicopter 武装直升机
anti-air fire 防空炮火

Text

The Evolution of Helicopters

(I) Although fixed-wing aircraft receive all the attention by most historians, helicopter



flight was the first flight envisioned by man. In fact, the ancient Chinese were playing with a hand-spun toy that rose upward when revolved rapidly and as early as^① the mid 1500's, the great Italian inventor Leonardo Da Vinci had used his fertile mind to make drawings of a machine that we now know as the helicopter.

His design, like many others to follow, would work theoretically but would have been impractical in full-

sized form.

Many extraordinary models were developed by an ever increasing number of great thinkers, but all the pioneers were missing two essentials: a true understanding of the nature of lift and an adequate engine.

① as early as:早在