

编译者的话 克里夫是以美国为基地的一家跨国公司的 CEO(首席执行官),也是我多年的朋友,他的事业非常成功,多次来中国,在北京的分公司业务发展很快,是一位成功的企业家。在他退休后我才知道他也是物理系毕业生。受《物理》编辑部的委托,我请他专门为《物理》杂志写一篇有关物理工作者和产业的文章,他欣然受命,收集了资料,整理了观点,写了这篇文章,由我译成中文。英文原文附后同时发表。

关于物理工作者和产业,关于物理学和高新技术,本刊曾在过去多次发表文章展开讨论。1993年6月2日,北京大学、中国科学技术大学和中国物理学会《物理》编辑部联合召开了“物理学人才问题”座谈会,就“物理学人才的优势与高新技术开发”专题进行座谈,会议纪要和重要的报告都曾在本刊发表(详见1994年第1期《物理》第25-29页)。我自己也多次现身说法。

物理学是一门最基础的自然科学,基础科学的发现是技术进步的源泉,对此大家都没有异议。然而,我们的讨论远未结束。严酷的事实在于,大学物理学的课时越来越少,四大力学变成讲座,物理系学生分配越来越困难,物理系大部分冠以或干脆换成“信息科学”等时髦的名字,产业界对物理系毕业生的认同感越来越差。物理工作者在产业界究竟有无用武之地?物理系毕业生有志投身产业界,究竟需要做什么准备?要补什么课?许多物理系毕业生到产业界工作后发挥不好,除了社会的原因外,是否也有必要找找自身的原因?而一个研究开发组内如果没有经过严格理论训练、具有系统、深厚理论功底 of 物理学工作者,创新从何谈起?多年来,中关村的生意越做越大,但自从北大方正汉字排版之后,真正有价值的创新就越来越少,与美国硅谷根本不可同日而语,原因究竟何在?

这个问题有否普遍性?在美国的情况如何,为此,我专门邀请克里夫·沃伦先生长谈,并写成此文。沃伦先生的文章观点鲜明,既讨论了物理学与当代技术的源与流的关系,更重要的是深刻解剖了物理工作者自身,明确指出他们的弱点和必须提高的修养,还专门讲了“情商”的问题,分析了成功的物理工作者所必须具备的四要素,即所谓4C(能力、交流、合作、敬业),我认为,这四条原则不仅特别适合于物理工作者,还具有普遍性。

我与克里夫的经历存在相似之处,但也有重要的差别,他的“变换”很彻底,完全是一位跨国公司的CEO,而我依然是“三尺微命,一介书生”。我常常感慨北京大学物理系的毕业生缺乏、不擅长4C中的交流与合作,特别是有些物理学的才子,自视清高,孤芳自赏,对时弊的批判太过深刻,对自身的弱点又太过宽容,往往与社会格格不入。他们本应成为社会和事业的栋梁,却因种种原因怀才不遇,不能不说是极大的遗憾与人才的浪费。

克里夫的文章还以自己成长的道路作为典型案例,描绘了一位物理学研究生成长为成功的经理的道路,内容非常生动而翔实。希望本文能引起物理学界的大学生、研究生、老师和产业界经理们的兴趣,并展开讨论。

(中国大恒集团公司 宋菲君)

物理工作者与产业*

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摘要 文章从产业发展的角度阐述了物理学与技术的源与流的关系,指出经典物理和理论物理仍然是几乎所有技术和产业的基础。在许多工程领域中,物理工作者都有机会成为优秀的企业家或销售经理,但他们通常不能如愿以偿,一个简单的原因在于他们缺乏与人交往的技巧。一个人要想在产业界有所建树,必须具备四个要素,即能力(competence)、交流(communication)、合作(cooperation)和责任心(commitment),也就是4C。文章描述了作者本人从一名物理系的研究生成长为美国非常有名的红外仪器公司的CEO(首席执行官)的经历。作为物理工作者出身的企业家,作者最深的感受在于,知识是重要的,但并不充分,必须牢记产业的最终目的是盈利。在产业界,利润和竞争是每天都存在的严酷的事实,上述的四个要素(4C)则是成功的法宝。

关键词 物理工作者,产业

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The role of physicists in industry

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Abstract Classical , or theoretical physics , is fundamental to nearly all engineering industries. Physicists can make excellent managers or marketers in their chosen field. However , usually they do not. The simple reason is a lack of “ people skills. ” Success of the individual is dependent upon the “ Four Cs :” Competence , Communication , Cooperation and Commitment. The author describes his own career from a graduate student to a CEO of a very successful American infrared instrument company. From the experience of the author , technical knowledge is important but not enough. One must understand that industry is in business to make a profit. In industry , where profit and competition are strong realities of everyday life , paying attention to the Four Cs are important factors for success.

Key words physicists , industry

1 引言

许多年轻的物理工作者和打算学物理的年轻人不了解他们今后在产业界有没有发展的机会和空间. 物理工作者在研究领域显然是大有可为的 , 几乎所有的诺贝尔物理学奖得主都在大学或者在政府和私立研究所工作 , 那么这是否意味着在产业部门没有物理工作者的位置呢 ? 答案显然是否定的. 事实上 , 工业部门有许多物理学工作者. 根据已发布的信息统计的结果 , 西方大学仅 30%—40% 的物理学博士继续留在研究领域 , 大部分人在产业界和其他部门的广阔天地里发挥着他们的聪明才智.

物理学研究成果构成了孕育新产品的平台 , 经典物理或理论物理仍然是当今几乎所有工程技术的根本基础 , 然而 , 工程技术却并不等同于物理. 实用的工程项目是非常复杂的 , 物理学仅仅是它的基础. 尽管有各种理论公式或经验公式描述这些项目和相关的技术 , 但直接把这些公式用到工程项目上得到的答案通常离实际问题的解决还很遥远.

事实上 , 物理学已经产生了许多近代技术 , 例如半导体、光学、光电子学、通信、医学、医疗及检测仪器、核子技术、航空航天学、汽车工业以及信息产业等 , 如果没有物理学和物理工作者的贡献 , 上述工业的形成是不可想象的. 无疑 , 在产业中物理学和物理学工作者起了非常重要的作用.

我们还是要问 , 在产业部门物理工作者和物理

系毕业生究竟有什么合适的岗位 ? 为了在产业部门发挥作用 , 他们应学点什么新的课程 , 而这些课程在科研岗位往往并不需要. 总之 , 为了成为一名成功的企业家 , 物理系学生应当作些什么准备 ?

2 当今产业界中的物理学

可以想象 , 在当今五花八门的技术门类中 , 物理工作者可以找到许多合适的工作机会. 例如电子学 (半导体、消费类电子产品、计算机、通信、广播设备) , 航空航天学 (宇宙飞船、飞机、导弹、舰船) , 医学 (诊断和治疗设备) , 核能工业 (核电站) , 仪器和检测 (红外检测、X 射线、光谱仪、超声波仪器) , 运动产品 (球拍、高尔夫球杆) , 军事工业 (武器、密码及其传输、探测器、导弹) 等等. 上述广阔的产业应用领域需要各专业的物理学人才 : 化学物理、计算物理、环境物理、声学物理、激光物理、光物理、高分子物理、应用物理、等离子体物理、精密测量物理、原子物理、晶体物理、介观物理、纳米技术、核物理、光学和光电子学、表面物理、同步加速器物理、统计物理、工业物理、凝聚态物理、液晶和玻璃、医学生物物理、辐射物理、神经网络、量子混沌和力学、固体物理和热动力学等等. 所有这些专业都出现在美国和欧洲的期刊中称作 “ Help Wanted ” 的人才招聘广告栏中.

然而并非都是好消息 , 尽管有如此广泛的专业需求 , 事实上物理工作者的人数在减少 (除中国以外) , 许多用人单位错误地觉得物理学太过于深奥

而抽象,离他们的应用太远.此外,许多物理工作者本身也有弱点,例如不合群,不善于把他们的新概念、新思维转化为产品.

3 对有志投身产业界的物理工作者的原则性指导

由于过去 50 年物理学的发展与渗透,近年来已形成许多交叉学科和交叉领域.物理系学生有必要尽早确定自己的专业方向,尽管学习经典的物理学是物理工作者一辈子的任务,但还是有必要寻求一个你最感兴趣的领域,甚至在考研以前就开始考虑.我建议选择那些充满兴趣、最有吸引力的方向,选择那些令你激动、你愿为之献身的领域.

一旦你选定了一个专业,就应当研究在该领域有那些公司,他们在做哪些产品?这些产品对社会有什么功效?一些尚处于初始阶段的产品是令人感兴趣的,因为这一阶段正需要物理工作者和工程师共同工作,将它们开发成产品,也许这些产品将在很长的时间内为你提供机会.

无论从我个人的经历还是从许多公司的情况来看,工程师和物理工作者在他们从事的领域内完全有可能成为出色的经理或营销人员.然而他们一般都未能如愿以偿,原因很简单:他们缺乏与人交往的技巧,缺乏所谓的“情商”(常称智商为 IQ,情商为 EQ).在产业部门工作,善于与人交往是至关重要的,这是对各级经理的基本要求,这一要求也同时适用于公司各层次的员工.优秀公司的实质是“cooperation”,是许多人的合作平台.

一个人是否成功取决于四个要素,即能力(competence),交流(communication),合作(cooperation)和责任心(commitment),也就是 4C.能力意味着你必要熟悉你所从事的专业,不断更新你的知识,还需要学习相关专业的知识,这其中包括生产和经营.必要时还可以回到学校去充电,学一个商业课程(例如工商管理硕士课程).

在公司中,与人交流、交往是必要的、经常的,而许多科学家和工程师却不愿这么做.事实上,一般性的交流还不够,还需要经常性的交流.我建议通过书面和口头的课程来建立成功交流的信心.

既具有坚实的专业基础,又具备灵活的交流技巧,你就具备了与你的同事和外界合作沟通的条件.这里的所谓外界,指的是客户(下游),供应商(上

游),政府机构、商界(周边)等等.个人的能力终究有限,合作共事才会有所建树,俗话说:众志成城.在交往过程中,发表意见前往往需要倾听、观察和思考,更需要谦虚.

具备了专门知识技能,熟谙了交流的技巧并开始合作后,下一步就是责任心或敬业精神.我们也许不必专门对学生或研究生提这样的要求,努力学习是学生的责任,否则就毕不了业,所以学生一般都得有责任心.常常发生这样的情况:工作若干年后,人们就渐渐失去了努力工作的责任心,缺乏敬业精神和热情,开始迟到、早退,不再努力学习,不再花力气跟踪本领域的最新进展;有些员工变得不可信赖.我们常常这样讲:你靠自己的知识受聘,你被自己的行为解雇(you get hired for what you know, but you get fired for who you are).

在产业界,利润和竞争是每天都存在的严酷的事实,上述的四个要素(4C)则是成功的法宝.

4 案例:克里夫·沃伦(本文作者)

60 年代后期的一天,一位地球物理学教授进入了夏威夷地球物理研究所的电子实验室,该实验室从属于夏威夷大学.他告诉总工程师,他需要一名电子技术员去协助研究小组操作、维护他们租来的由瑞典生产的红外成像系统.当时我是该实验室工作的一名研究生(见图 1),总工程师叫我来协助这位教授.



图 1 克里夫·沃伦(右)作为一名研究生,正在修理红外照相机

对我的业务生涯而言,这是一个里程碑.我从此与红外技术结下了不解之缘,直到 35 年后我退休.后来我曾长期担任加州圣·克鲁兹(Santa Cruz)的雷泰(Raytek,请参见 www.raytek.com)公司的

CEO, 该公司开发、生产先进的红外测量仪器。

在我协助教授工作后不久,就以我的硕士论文的研究课题为基础加盟了研究小组。研究课题就是用红外成像方法探测海水从夏威夷岛的海岸溢流效应。研究工作进展顺利,发表了多篇论文。随着新发表论文的广泛传播,密歇根大学的 Willow Run 实验室邀请我去申请博士学位奖学金。Willow Run 是美国国防系统有名的红外技术研究室,并计划把部分技术转向民用。由于我在夏威夷的经历,成为该计划的最佳候选人。

在密歇根大学期间,我有可能把物理学中严格的辐射理论与我过去在试验中遇到的红外成像系统以及环境遥测联系起来。然而由于种种个人的和实际的困难,我未能最终完成这一课题。

就在此时,瑞典的一个生产红外成像仪器的公司到 Willow Run 实验室来对我进行面试,在夏威夷我曾用过他们生产的仪器。他们打算在美国开设一家新公司,需要一位高技术人才,通过在美国巡回讲课、做报告的方式,把这种红外成像仪推销到工业界及科技用户,这个推销模式后来遍及世界各国。他们还希望这位推销人员与探测器、光学和小型电机的供应商建立联系。

作为市场和工程部的一名客户联络经理,我走遍了美国和许多其他国家,1979年还来过中国。此后,公司邀请我在瑞典斯德哥尔摩从事一年的课题研究,我们全家,我太太和两个孩子一同前往瑞典。经过公司内部管理层的多次调整、重组,三年后我被任命为 AGA 红外系统 AB 公司总裁,该公司现在是 FLIR 公司的子公司,成为世界商用红外成像系统的主要供应商。

后来,我应美国雷泰公司当时的老板之邀加盟该公司。在初始阶段经营很艰难,不断亏损,结果公司的经理人员购买了公司 55% 的股份,我成了公司的 CEO,公司迅速成长起来,逐渐发展成为有 300 名员工、6 个海外分公司的集团公司,一半成员在美国以外(见图 2)。两年前雷泰公司被另一家大的跨国企业集团并购,我自己也由此退休了。

从个人的经历中我学到了什么?首先,我学习了技术,尽管这是头等重要的,但并不充分。谁都清楚公司必须获利。利润并不是坏事,至少,它是公司效率的最根本的度量,它又是公司业务成长及其员工收入增加的动力。销售额来自客户,重要的是弄清



图2 克里夫·沃依(右)与他的经理班子在2000年北京会议上

楚谁是客户,他们为什么买你的产品?或者他们为什么不买你的产品?这一观念协助我得到了经济学的硕士学位,使我从一个机械工程师成长为业务经理。经理人员,或者更加准确地说,领导层的才华对公司成功与否是至关重要的。CEO 除负责公司大部分业务以外,他的魅力还体现在他在本领域中的专业能力,他对员工的理解程度,他对公司未来发展的运筹等等。作为员工们尊敬、钦佩的领头人,大家会跟他走,与他一起努力创业。

5 我学到了什么

- 对于年轻的大学生和研究生,最重要的是及早决定自己要从事的领域,要走的路。当你选定了你最感兴趣的方向后,应当想象你将为之奋斗 30 年。不要有所顾忌,时间将证明你的决定是否正确。
- 把你物理学的兴趣开拓到与人合作交往的技能方面,例如语言训练,历史、哲学的学习等。这将非常有助于你与人共事,也就是我们上面谈到的 4C。
- 学习如何成为团队中的一员,并观察、学习如何成为这个团队的领袖的艺术。
- 最终,你必须为你自己和你的公司创造财富,为此,必须学习怎样通过公正、规范的方法来赚钱。
- 享受你的物理学生涯,它将永远与你同在。

编译者简介

宋菲君 男,1966 年毕业于北京大学物理系,现任中国大恒集团公司董事、副总裁兼总工程师,研究员,博士生导师,中国物理学会理事,中国光学学会常务理事,《物理》杂志编委。

附录 《物理工作者与产业》原文

The role of physicists in industry

Cliff Warren

(Santa Cruz , California , USA)

1. Background

Many young people looking at physics as a career wonder what opportunities actually exist in industry. Obviously , there are many opportunities in academia. Nearly all Nobel prize winners in Physics hail from Universities or Technical Institutes , government or private. Are there no positions for physicists in industry ? Actually , there are many physicists in industry. In fact , according to published data , of all the PhD physicists graduating from Western universities , only 30%—40% remain in academia , while the majority does go to work for a wide range of employers in many industries.

Much of academic physics becomes the platform upon which new products are built. Classical , or theoretical physics , is fundamental to nearly all engineering. However , product engineering is not academic physics. Practical engineering can be tremendously complicated ; while the basic physics is usually taken for granted. Although the relevant fundamental equations are in place , applying them to the problem at hand and creating solutions that can be used in practice is rarely straightforward.

Indeed , physics has enabled many modern technologies such as semi-conductors , optics and opto-electronics , telecommunications , biomedicine , medical and industrial instrumentation , nuclear technology , aerospace , motor engineering and even information technology. None of these technologies could have existed without the employment of physicists. No doubt , physics and physicists do play an important role in industry.

Still , it can be asked , what opportunities exist for physicists in industry ? What additional skills are needed for a career in industry that might not be needed in academia ? What can a physics student do to prepare for a successful career in business ?

2. Physics in Industry Today

One can easily imagine that with such diverse technologies existing today , physicists can be found in a wide range of industries. This is indeed the case. Physicists can be found in electronics (semiconductors , consumer products , computers , telecommunications , broadcasting , entertainment) , aerospace (aircraft , space , rockets , navigation) , medicine (diagnostic and therapeutic devices) , nuclear (power stations) , transportation (both private and public transport) , optical (cameras , microscopes , telescopes) , instrumentation (infrared , X-ray , spectroscopy , ultrasound) , sports (racquets , golf clubs) and military (armaments , encryption , sensors , missiles) .

From this wide range of industries has come a demand for a wide range of physics specialties : chemical physics , computational physics , environmental physics , material physics , acoustic physics , laser physics , optical physics , polymer physics , applied physics , plasma physics , measurement science physics , atomic physics , crystallography , mesoscopic physics , nanotechnology , neutron physics , optics and opto-electronics , surface physics , synchrotron physics , statistical physics , industrial physics , condensed matter physics , liquid crystal and glasses , bioinformatics , radiation physics , neural nets , quantum chaos and mechanics , solid state physics and thermodynamics. All of these specialties have been taken from actual " Help Wanted " ads in North America and Europe.

It is not all good news. In spite of the wide and expanding range of specialties , in fact , the number of physicists (outside of China) are not growing. For many employers , physicists are erroneously seen as being too abstract or too esoteric for their needs. Moreover , many physicists are seen to be lacking generic skills such as team work , business awareness , self-management and

the ability to "sell" their ideas for new products.

3. Guidelines for Physicists Hoping to Work in Industry

Given the expansion of the field of physics in the last 50 years, it is necessary to specialize at the earliest possible time. Although learning classical and fundamental physics can occupy a lifetime, it is advantageous to find the branch of physics you are most interested in even before graduate school, but certainly by the time of a Masters program. My advice is to find a subject that you are passionate about; something that excites you and something you can imagine doing for the rest of your life.

Once you have chosen a specialty (or to help choose a specialty), investigate what companies are working in that field; what products do they make; how do those products benefit society. Products at a very early but promising stage of development are interesting since there will be a demand for physics and engineers to develop them and they will provide a opportunity long career.

From my own experience and from what I have seen in many companies, engineers and physicists can make excellent managers or marketers in their chosen field. However, usually they do not. The simple reason is a lack of "people skills". To work in industry it is very important to have good "people skills". While this is essential in management, it is also true at all levels. Good physicists often get immersed in their work and forget that in industry a successful company is a "cooperation" of many people.

Success of the individual is dependent upon the "Four Cs": Competence, Communication, Cooperation and Commitment. Competence is knowing your field and continually updating your knowledge. It's a lifelong effort. It does not stop when you graduate or get your first job. Not only do you need to increase your knowledge of your own field, but also the knowledge of related fields, including the industry and business you are in. It may even be valuable to return to school to earn a business degree (MBA).

In a company, it is always necessary to Communicate – something many scientists and engineers regularly

avoid. Not only is it necessary to communicate, it is necessary to communicate in a timely fashion. I suggest taking some writing and speaking courses to build confidence in effective communications.

With a deep competence in your specialty and effective communication skills, you are ready to cooperate with your colleagues in your company as well as the external world: customers, suppliers, government agencies, trade societies, etc. . . One can not build a castle alone. It takes the effort of many people working together. Learning how to cooperate with others is critical to the success of the mission. Sometimes it only takes listening, observing and thinking before reacting or speaking. More often, it only takes humility.

Once Competence is achieved, Communication flowing and Cooperation underway, the next very important requirement is Commitment. Perhaps as a student this seems unnecessary since to study hard and graduate requires a lot of commitment. But, what often happens is that people lose their commitment to hard and reliable work after some years of working. They start coming to work late and leaving early, they do not keep up with new developments in their field, or they become generally untrustworthy. We often say "you get hired for what you know, but you get fired for who you are".

In industry, where profit and competition are strong realities of everyday life, paying attention to the Four Cs are important factors for success.

4. Case Study : Cliff Warren

One day in the late 1960s, a Professor of Geophysics entered the Electronics Laboratory of the Hawaii Institute of Geophysics, a part of the University of Hawaii in Honolulu. He told the Chief Engineer that he needed an electronics technician to help his research group operate and maintain a new Swedish – produced infrared imaging system they were renting for their project. I was a graduate student working in the lab at that time. The Chief Engineer called me over and asked me to help the professor.

From that date on, my career in infrared technology started and did not end until some 35 years later when I retired as President and CEO of Raytek, a Santa Cruz, CA, company, a leader in infrared measuring devices (www.raytek.com).

Soon after I began helping the professor ,I was asked to join the research team and base my Master's thesis on their research project. The project involved the use of airborne infrared imagery for detecting fresh water outflows from the coastal regions of the island of Hawaii. It was highly successful and a number of papers were published. With the newly published papers widespread ,I was asked by the University of Michigan's Willow Run Laboratories to apply for a fellowship in their PhD program. Willow Run was a very famous laboratory in military infrared technology and wanted to expand their program to include more civilian applications. With my experience in Hawaii ,I was a perfect candidate for their new program.

At the University of Michigan ,I was able to combine their excellent theoretical radiation physics program with my past practical knowledge of using infrared imaging systems for remote sensing of the environment. However ,for various personal and practical reasons ,I was not able to conclude my program.

As it happened ,the original Swedish company that produced the infrared imager I used in Hawaii ,came to the Willow Run Labs to interview me for a new position they had recently opened in the USA. They wanted a highly technical person to promote their new imager to industrial and scientific users by giving lectures and speeches around the country (later worldwide). They also needed the same person to liaison with their qualified suppliers of detectors ,optics and micro motors.

After some years as a Technical Liaison for the Marketing and Engineering Departments ,traveling throughout the USA and even many other countries (including China in 1979) ,I later was invited to work in Stockholm ,Sweden ,for a one year project. I moved my family ,including my wife and two children ,to Sweden. Following a number of management changes and reorganizations ,after three years ,I became the President of the company ,AGA Infrared Systems AB (now a part of the FLIR group ,www.flir.com). They were the leading worldwide company in commercial infrared imaging systems.

From Sweden ,I was recruited to Raytek on the invitation of the then sole owner of the company. The company was struggling and losing money. Eventually ,the

management team bought out 55% of the company and grew it to be the leading company in its field with more than 300 employees and 6 foreign offices ,one half of the employees based outside of USA. Finally ,the company was sold to a large conglomerate two years ago and I retired.

What have I learned from this experience ?Most of all ,I learned that technical knowledge ,although number one in importance ,is not enough. You must understand that industry is in business to make a profit. Profit is not a bad thing. In fact ,it is the ultimate measurement of the efficiency of the entire company. Moreover ,it provides the fuel to allow the company (and its people) to grow and develop. Revenues come from sales to customers. It is important to learn who the customers are and why they buy or do not buy the company's products. (It also helped me to take a Masters in Business to increase my knowledge of the mechanics of running a business.)

Management ,or more correctly ,leadership skills are very critical to the success of any company. The CEO leads most of all by example : his competence of his field ,his understanding of his people ,and his vision of the future. People will follow and work very hard for a leader they respect and admire.

5. What I Have Learned

- For young students and even recent graduates ,it is important to decide on a career path as early as possible. Base your decision on what interests you the most ,what you can imagine working with for the next 30 years. Don't worry if the decision is correct or not ,only time will tell.
- Broaden your interest in physics with other more people - oriented skills such as language training ,history or philosophy. This helps in eventually working with people and the Four Cs.
- Learn how to become a team player and observe the skills needed to become a leader.
- Ultimately ,you need to create wealth for yourself and your company so learn how this is achieved in a fair and ethical manner.
- Enjoy your career in physics ;it will live with you forever.