The Nobel Prize

诺贝尔奖100周年

edited by

Agneta Wallin Levinovitz
Nils Ringertz

The First 100 Years

World Scientific
世界图书出版公司

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The Nobel Foundation
Stockholm, Sweden

Imperial College Press

World Scientific
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Published by

Imperial College Press
57 Shelton Street
Covent Garden
London WC2H 9HE

and

World Scientific Publishing Co. Pte. Ltd.
P O Box 128, Farrer Road, Singapore 912805
USA office: Suite 1B, 1060 Main Street, River Edge, NJ 07661
UK office: 57 Shelton Street, Covent Garden, London WC2H 9HE

British Library Cataloguing-in-Publication Data
A catalogue record for this book is available from the British Library.

THE NOBEL PRIZE: The First 100 Years

ISBN 981-02-4664-1
ISBN 981-02-4665-X (pbk)

书　　名：The Nobel Prize: The First 100 Years
作　　者：Agneta Wallin Levinovitz , Nils Ringertz
中 译 名：诺贝尔奖 100 周年
出 版 者：世界图书出版公司北京公司
印 刷 者：北京世图印刷厂
发　　行：世界图书出版公司北京公司（北京朝内大街 137 号　100010）
联系电话：010-64015659, 64038347
电子信箱：kjsk@vip.sina.com
开　　本：24 开　　印　张：10.5
出版年代：2004 年 4 月
书　　号：7-5062-6561-3/O・423
版权登记：图字:01-2004-1612
定　　价：32.00 元

THE WILL OF ALFRED NOBEL

The Nobel Foundation was established under the terms of the will of ALFRED BERNHARD NOBEL, Ph.D.h.c., dated Paris, November 27, 1895, which in its relevant parts runs as follows:

"The whole of my remaining realizable estate shall be dealt with in the following way: the capital, invested in safe securities by my executors, shall constitute a fund, the interest on which shall be annually distributed in the form of prizes to those who, during the preceding year, shall have conferred the greatest benefit on mankind. The said interest shall be divided into five equal parts, which shall be apportioned as follows: one part to the person who shall have made the most important discovery or invention within the field of physics; one part to the person who shall have made the most important chemical discovery or improvement; one part to the person who shall have made the most important discovery within the domain of physiology or medicine; one part to the person who shall have produced in the field of literature the most outstanding work in an ideal direction, and one part to the person who shall have done the most or the best work for fraternity between nations, for the abolition or reduction of standing armies and for the holding and promotion of peace congresses. The prizes for physics and chemistry shall be awarded by the Swedish Academy of Sciences; that for physiology or medical works by the Carolinska Institute in Stockholm; that for literature by the Academy in Stockholm, and that for champions of peace by a committee of five persons to be elected by the Norwegian Storting. It is my express wish that in awarding the prizes no consideration whatever shall be given to the nationality of the candidates, but that the most worthy shall receive the prize, whether he be Scandinavian or not."

Preface

In the year 2001 the Nobel Foundation celebrates the Centennial of the first Nobel Prizes. Among the events for 2001 is the opening of a Centennial Exhibition in Stockholm. An identical exhibition will open in Oslo in the fall of 2001 and then tour different cities around the world. The Nobel web site has been upgraded to Nobel e-Museum (NeM) — a virtual museum of science and culture which can be found on the Internet at www.nobelprize.org.

As part of the Centennial celebrations, the NeM is publishing a series of reviews covering the work of Nobel Laureates in Physics, Chemistry, Physiology or Medicine, Literature and Peace as well as Winners of the Bank of Sweden Prize in Economic Sciences in Memory of Alfred Nobel (awarded since 1969). Electronic publication of this series began in 1999 and has now been completed. In view of the great interest in these reviews, and to make the information available also to those who prefer to read from printed pages, a collaboration has been established with Imperial College Press and World Scientific to publish updated versions of these reviews in the form of this Centennial Volume.

We wish to thank all the contributing authors and Gudrun Franzén, administrator of the Nobel e-Museum, for her advice and help at all stages of preparing the manuscript for this volume. Thanks are also due to Dr Ola Törnkvist, Imperial College Press, London and Ms Kim Tan, World Scientific, Singapore for the copy-editing and efficient production of this volume.

Agneta Wallin Levinovitz Nils Ringertz

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Introduction

*Michael Sohlman**

The celebration of the Centennial of the Nobel Prizes in 2001 brings with it i.a. a perspective on the development of human civilization over the past hundred years. The disciplines covered by the Nobel Prizes — Physics, Chemistry, Physiology or Medicine, Literature and Peace, as well as the Bank of Sweden Prize in Economic Sciences in Memory of Alfred Nobel (from 1969) — deal with many, if not all, major aspects of the conditions of life on earth. And even if the Prizes have obviously not been able to capture all the most important contributions to the progress of Mankind, they constitute important markers of the major trends in their respective area. The articles included in this volume have the ambition to convey these major trends and developments.

When gauging the meaning and development of the Nobel Prizes, a natural starting point is to ask what Nobel himself intended with the Prizes. His intentions and the criteria he envisaged for the five disciplines are given in his last will, but they remain very broad, and as is clear from the following articles, have necessitated interpretation over the years, an interpretation which remains constantly on the agenda of the Prize-Awarding Institutions.

It is also clear that some of his intentions — that the award would go to "those who, during the preceding year, shall have conferred the greatest benefit to mankind" were impossible to fulfil already from the start: what economists call information-, recognition- and decision-lags were and are still too long.

*Executive Director of the Nobel Foundation.

We also have reason to think that Nobel — at least in the scientific disciplines — had in mind that young, talented inventors should be given a safe financial basis for their work and thereby be spared the constant trouble in finding financiers at the start of their career, as was the case for Alfred Nobel himself. Here the history shows that the Prizes have rather concentrated on the importance of the discoveries, inventions, literary works and pacifist ventures, than on encouragement of young talents. And in our days governments are financing research grants and scholarships, and a rapidly expanding venture capital market provides young start-up entrepreneurs with the needed capital.

Looking back with the perspective of a century, the question arises: What explains the present-day position of the Nobel Prizes? One answer is that the Nobel Prize when it was founded in Alfred Nobel's will, was the first truly international Prize. A number of important Prizes had been awarded in different countries on a national basis long before the Nobel Prizes. But there was no Prize with the same global and internationalist scope and mission. The Will says explicitly that "no consideration whatever shall be given to the nationality of the candidates." This was an important humanistic signal at a time when nationalism and chauvinism was on the rise. Indeed, the system of values underlying the provisions of the last will of Alfred Nobel mirrors his philosophical outlook with its combination of the ideals of the Enlightenment and strong optimism about the rapid progress of mankind. From the correspondence between Alfred Nobel and Bertha von Suttner, it is moving to learn that they thought that the eradication of war, as a kind of human behavior, would be a matter of 20–30 years, i.e. approximately around 1914.

The main reason for the standing of the Prize today is, however, the importance of the names on the list of Laureates and their contributions to human development. And it has been the difficult task of the Prize-Awarding Institutions over the years, to interpret the last will of Alfred Nobel in the light of a constantly changing world. In this work they are assisted in a decisive way by colleagues and experts from all over the world, who participate in the award process, either as nominators and/or as contributors to the evaluation of the different candidates. This wide network of contacts gives the Prizes the character of recognition by peers in the respective field.

On the threshold of the next century of Nobel Prizes, the Prize-Awarders face the daunting task to combine the criteria and formal limits of Nobel's last will with the ever-changing reality of science, literature, and striving for peace.

As a sign of our times, this volume consists of overview articles first written for the official web site of the Nobel Foundation — www.nobel.se. By being printed in this volume the unstoppable progress of Mankind from 'Gutenberg to Gates' has been temporarily halted for the benefit of readers who still enjoy holding a book in their hands.

Life and Philosophy of Alfred Nobel*

*Tore Frängsmyr***

Probably no Swede is as well-known throughout the world as Alfred Nobel — not our medieval saints, nor even our contemporary sports heroes. At the same time, we must admit that his renown is more indirect than direct. This means that while the Nobel Prize is extremely well-known all over the world, the person behind it remains relatively unknown.

Admittedly, quite a lot has been written about Alfred Nobel, but a large part of this literature consists of clichés. It is often a question of sentimental depictions of a lonely millionaire who — despite his wealth — was unhappy or at least deeply melancholic, emotionally attached to his mother, and with a few heart-rending love stories behind him. This is not altogether a false picture. Alfred Nobel was lonely and he was clearly unlucky in love, but such accounts are not so instructive. Romantic tales constitute a special genre, to which I shall not attempt to contribute. Instead, I will focus on the scientific and technical fields.

First, however, I would like to recount some important facts about Alfred Nobel's life. He was born in Stockholm in 1833 into a family of engineers. His family was descended from none other than Olof Rudbeck, the best-known technical genius of Sweden's 17th century era as a Great Power in Northern Europe. Having gone through a recent bankruptcy, when Alfred was five years old his father Immanuel Nobel moved to St. Petersburg, where he started a mechanical workshop for the manufacture

*Memorial address at the Royal Swedish Academy of Sciences, March 26, 1996.

**Director of the Center for History of Science at the Royal Swedish Academy of Sciences.

of land mines. In 1842, when Alfred was nine years old, the rest of the family also moved to St. Petersburg. By then his father's fortunes had improved, enabling the family to live in high bourgeois style. At the time, St. Petersburg was a world metropolis, alive with scientific, social, and cultural life. Immanuel Nobel's sons did not attend school, but were instead educated at home by outstanding teachers at the level of university professor. The instruction they provided focused on both the humanities and the natural sciences. Aside from Swedish, Alfred and his brothers were taught Russian, French, English and German, as well as literature and philosophy. In the natural sciences, they were guided by two professors of chemistry who taught them mathematics, physics and chemistry. Considering the specialty of his teachers, it was perhaps no coincidence that Alfred took a liking to chemistry. He learned to conduct chemical experiments, an activity that seemed to fascinate him from the very beginning. Alfred spent his most important formative years in the Russian capital. With his five languages, which he seemed to have mastered well, he laid the foundation for the cosmopolitan nature that would later become so prominent in his life.

During the years 1850–1852, Alfred was allowed a few study-oriented stays abroad. He spent one year in Paris with the famous chemist Jules Pelouze, a professor at the Collège de France who had just opened a private training laboratory. Pelouze, who incidentally had been a good friend of the Swedish chemist Berzelius, had also taught Nikolai Zinin, one of Alfred Nobel's private teachers. During that year, Alfred completed his training as a chemist. But somewhere around the same time was the inception of what would become the greatest inventions of his life. For it was then, if not earlier, that he must have heard about the remarkable explosive called nitroglycerine. Strangely enough, this has not been pointed out by many scholars, who have dated the crucial moment 10 years later.

Here is the background. In 1847, in Turin, Ascanio Sobrero — an Italian student of Pelouze — had discovered a new explosive that he initially called pyroglycerine (later known as nitroglycerine). However, Sobrero, both in letters to Pelouze and in a subsequent journal article, issued a warning about the new compound, not only because it had incredible explosive power, but also because it was impossible to handle. Sobrero's discovery did not come as a bolt from the blue. As early as the 1830s, Pelouze himself and others had conducted important preliminary work by making guncotton. Since Alfred was extremely interested in explosives — it was of course a family interest — and since Pelouze had both first-hand knowledge of how explosives were manufactured and was familiar with Sobrero's

discovery, Alfred must have learned about nitroglycerine at that time. However, any excitement he might have felt was immediately dampened by the difficulties of both manufacturing and handling the new compound.

The end of the Crimean War (1856) spelled disaster for Immanuel Nobel's factory, which had lived off the manufacture of war materiel. The factory went bankrupt, and Alfred's parents and their youngest son Emil moved back to Sweden. The three older sons stayed in St. Petersburg to put the family affairs in order and restructure the company. Faced with this situation, Alfred and his brothers discussed various conceivable projects with their former teachers. That was when Nikolai Zinin reminded them of the potential of nitroglycerine. Professor Zinin is said to have demonstrated the power of nitroglycerine by pouring a few drops of the fluid on an anvil, striking it with a hammer, and producing a loud bang. But only the liquid that came into contact with the hammer exploded. The rest of the liquid was not affected. The problem, as Sobrero had already realized, was two-fold. First, it was difficult to manufacture the compound, because at excessive temperatures the whole batch exploded. Second, once manufactured, the liquid was equally difficult to explode in a controlled fashion.

During the years around 1860, Alfred conducted repeated experiments involving great risks. First, he succeeded in manufacturing sufficient quantities of nitroglycerine without any mishaps. Then, he mixed nitroglycerine with black gunpowder and ignited the mixture with an ordinary fuse. After several successful explosions outside St. Petersburg on the frozen Neva River, Alfred traveled back to Stockholm. There, his father had begun similar experiments (though with less success) after reading about Alfred's tests in his letters. Immanuel Nobel even insisted that the new mixture was his own idea, but he backed off from this assertion after a sharp letter from Alfred that set matters straight in no uncertain terms. Instead, he even helped Alfred apply for a patent in his own name. In October 1863, Alfred Nobel was granted a patent for the explosive that he aptly called 'blasting oil'.

With his first patent, Alfred had also reached his first milestone. Although he was only 30 years old, this was the start of an exciting adventure that would unfold with great speed. During the following spring and summer, Alfred continued his experiments. He soon obtained a new patent related to the manufacture of nitroglycerine (using a simplified method) as well as the use of a detonator, or what was called an 'initial igniter', in other words a hollow wooden plug filled with black gunpowder (later called a 'blasting cap'). The determination and self-confidence that would later become more pronounced features of Alfred's personality were already apparent. He wrote: "I am the first to have brought these subjects from

the area of science to that of industry," and he successfully arranged a large loan from a French bank.

Around the same time, another personality trait began to assert itself — the inventor also became an entrepreneur. Alfred dealt with failures in the same resolute manner as he did successes. In September 1864, a major explosion at the Nobel factory in Stockholm claimed the lives of Alfred's brother Emil and four other people. Just one month later, Alfred — resolutely and without sentimentality — founded his first joint stock company. Despite the accident or perhaps because of it, since no one could now doubt the explosive power of the new compound, orders began rolling in. The Swedish State Railways ordered blasting oil for use in building the Söder Tunnel in Stockholm. A year later, in 1865, Alfred improved his blasting cap (now made of metal rather than wood) which in principle is still of the same type used today. He then left for Germany, set up a company there and bought land outside Hamburg where he built a factory. In the summer of 1866, Alfred Nobel traveled to America. There he struggled against political bureaucracy, popular fear of accidents caused by explosives and, not least, dishonest business associates. In the end, he received patents, formed companies and built factories there.

Despite slow communications, everything now happened very quickly. Events literally assumed explosive force. While Alfred was in America, his factory in Germany exploded. When he returned to Germany in August, he had to supervise the clean-up of the debris and plan a new building. At the same time, he continued to brood over the safety problems of nitroglycerine and he conducted new experiments. He realized that nitroglycerine had to be absorbed by some kind of porous material, forming a mixture that would be easier to handle. On the German moorlands very close to where he was staying, he found a type of porous, absorbent sand or diatomaceous earth known in German as Kieselguhr. When nitroglycerine was absorbed by Kieselguhr, it formed a paste that was easy to knead and shape. This paste could be shaped into rods that were easily inserted into drilling holes. It could also be transported and subjected to jolts without triggering explosions. It could even be ignited without anything happening. Only a blasting cap would cause the paste to explode. The disadvantage of this new substance was its somewhat reduced explosive force — the Kieselguhr did not participate as an active substance in the explosion. But this was the price one had to pay. In short, that was how Alfred Nobel invented dynamite. Incidentally, Alfred himself coined the word dynamite from the Greek dynamis, meaning power. One of his German colleagues had proposed the term 'blasting putty' because it had the same consistency