

# **Social Studies of Science**

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**An International Review of Research in the  
Social Dimensions of Science and Technology**

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**Volume 20 Number 1  
February 1990**

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**Editors  
David Edge  
Roy MacLeod**

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*Social Studies of Science* is devoted mainly to the results of original research, whether empirical or theoretical, which bring fresh light to bear on the concepts, processes, mediations and consequences of modern natural science and technology. It is multi-disciplinary in the sense that it encourages appropriate contributions from political science, sociology, economics, history, philosophy, psychology, social anthropology, and the legal and educational disciplines. It welcomes studies of fundamental research, applied research and development; of university science, industrial science and science in government; of all aspects of technological innovation; and from all countries.

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1. J. Ben-David and R. Collins, 'Social Factors in the Origins of a New Science: the Case of Psychology', *American Sociological Review*, Vol. 31 (1966), 451-65.
2. L. Pearce Williams (ed.), *The Selected Correspondence of Michael Faraday*, Vol. 1 (London: Cambridge University Press, 1971), 113-19.
3. Ben-David and Collins, op. cit. note 1, 461.
4. Ibid., 460.

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## An Abstract

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*Studies of the creation of networks in science have rarely focused on the role of research materials in establishing relations between actors. This paper considers the question of how scientists' changing needs for research materials in the study of sex hormones, which emerged as a new field of the life sciences at the turn of the century, shaped both the character of the relations between the actors in endocrinological research, and the strategic position of each actor. The accessibility of research materials not only shaped the social organization, but also affected the cognitive development, of sex endocrinology. In this process, gender bias in science was reinforced and metamorphosed.*

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## **On the Making of Sex Hormones: Research Materials and the Production of Knowledge**

**Nelly Oudshoorn**

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**In the last decade, the study of laboratory practices has emerged as a new line of enquiry in social studies of science. To understand the construction of the laboratory, Latour suggests that laboratory scientists should be studied in their daily practices. According to Latour, laboratories are characterized by the activities of laboratory scientists who create networks with other actors, both human and non-human, in order to improve and maintain the position of the laboratory as the very centre of authority.<sup>1</sup> However, Latour does not specify the role of non-human resources (for example, research materials) in the building of networks. The role of research materials in the production of knowledge has recently been studied by Clarke. In her analysis of the impact of research materials on the social organization of research in the reproductive sciences, Clarke described how, in the life sciences at the turn of the century, the shift from descriptive morphological approaches to experimental physiological approaches radically altered scientists' needs for research materials. The new experimental approaches entailed drastically different means of gaining access to research materials, and**

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had a crucial impact on the infrastructure of the reproductive sciences. Clarke has described the emergence of the formal and informal networks reproductive scientists created in order to obtain the required research materials.<sup>2</sup> However, Clarke's analysis did not take into account the role of the clinic and the pharmaceutical industry, both major actors in the life sciences.

This paper seeks to evaluate the role of research materials in structuring the relationships between the laboratory, the clinic and the pharmaceutical industry. It focuses on the study of sex hormones, which emerged as a new field in the life sciences at the turn of the century. How did the scientists' changing needs for research materials affect the relationships between the actors involved in the emerging field of sex endocrinology? To answer this question I will follow the actors in their efforts to gain access to the required research materials. I will describe how laboratory scientists had to create networks with both gynaecologists and the pharmaceutical industry to satisfy that need. The accessibility of research materials affected both the character of the relationships between the actors, and the strategic position of each actor involved in these networks.

Furthermore, I will analyze how access to research materials affected cognitive developments in the emerging field of sex endocrinology. These materials were not merely a resource, but functioned as carriers of knowledge claims. I will describe how gender bias in science was reinforced and metamorphosed in this process.<sup>3</sup>

## **Under the Spell of the Glands**

The study of hormones emerged as an important field of research in the life sciences at the turn of the century. Since the 1890s, physicians had suggested that the 'internal secretions' of certain organs were crucial to an understanding of physical processes in the human body. At the beginning of the twentieth century, British physiologist Ernest H. Starling reformulated this theory of internal secretions with the introduction of the concept of hormones: 'these chemical messengers or "hormones" as we may call them, have to be carried from the organ where they are produced to the organ which they affect, by means of the blood'.<sup>4</sup> The most conspicuous actor advocating the doctrine of the glands was French physiologist Charles-Edouard Brown-Séquard, who drew attention to the role of the sex glands. In 1889 he announced to his colleagues in Paris that preparations made of testes (the male sex glands) could promote

eternal youth and sexual activity in men. Brown-Séquard also reported the practice of a medical woman in Paris who had injected women with the filtered juice of guinea-pigs' ovaries (the female sex glands) in treatment of various uterine affections and hysteria. Brown-Séquard's advocacy gave rise to a widespread interest in the 1890s in what was called 'organotherapy': the use of extracts of animal organs as therapeutic agents.<sup>5</sup> The very idea that animal organs contained potent substances regulating all kinds of physical processes created an atmosphere full of expectations and excitement: 'It's all in the glands'.<sup>6</sup>

The concept of the glands as organs that secreted potent substances regulating physical processes indicated a new line of research. In the nineteenth century, physiologists had assumed that all responses in the body were regulated by nervous stimuli. Many physiological responses, however, could not be explained adequately in terms of the model of nervous pathways. The concept of chemical substances secreted by the glands and transported by the blood provided scientists with a new model of explanation, and triggered a new experimental approach in laboratory science. At the turn of the century, scientists began to search actively for the chemical substances in the sex glands, using the techniques of castration and transplantation.<sup>7</sup> In this surgical approach, scientists removed ovaries and testes from animals like rabbits and guinea-pigs, cut them into fragments and reimplanted these into the same individuals at locations other than the normal positions in the body. With these experiments, scientists tested the concept of hormones as agents having control over physical processes without the mediation of nervous tissue. In transplantation, the nervous tissue of the glands was dissected, so the effects of the reimplanted glands on the development of the organism had to take place through another medium – for instance, the blood. Following advances in organic chemistry in the late 1910s, the surgical approach of transplanting gonads was replaced by chemical extraction of the gonads. These extracts were subsequently injected into castrated animals in order to investigate their function.

The chemical substances believed to originate in the sex glands were designated sex hormones: the male sex hormone secreted by the testes, the female sex hormone secreted by the ovaries.<sup>8</sup> This terminology constructed a sexual duality: sex hormones were conceptualized as the chemical agents of masculinity and femininity, thus emphasizing the ancient folk-wisdom that femininity and masculinity resided in the gonads.<sup>9</sup> Although, in the 1920s and 1930s, scientists had to reconsider the conceptualization of sex hormones as strictly sexually specific both in origin and function, the terminology was never revised. Since the

1920s, the names 'male' and 'female' sex hormones have continued in use, both inside and outside the scientific community.<sup>10</sup>

The assumption that sex hormones were the agents of masculinity and femininity functioned as a paradigm. Previously scattered research was focused around a generally accepted theory, 'opening new lines of research into sexual differentiation, menstruation, and fertility'.<sup>11</sup>

The emerging field of the study of sex hormones attracted different groups of actors to the scene. Surprisingly, gynaecologists, and not the laboratory scientists, were the first to recognize the relevance of the theory of internal secretions to the sex glands. Gynaecologists were already familiar with the changes in the body that followed the removal of ovaries, and directed their research to the chemical messengers of the ovaries: the female sex hormones. As early as 1896 and 1900, two Viennese gynaecologists, Emil Knauer and Josef Halban, described the secretion of chemical substances by the ovaries.<sup>12</sup> Gynaecologists came under the spell of the glands because of their therapeutic promises. The concept of female sex hormones promised a better understanding of, and therefore greater medical control over, the complex of disorders in their female patients frequently associated with the ovaries, such as disturbances in menstruation and various nervous diseases. Moreover, by linking female disorders to female sex hormones, 'women's problems' remained inside the domain of the gynaecologists.<sup>13</sup>

Although no one yet knew what the physiological effects of injections of extracts of the testes and ovaries might be, there already existed a widespread paramedical practice in gonadal preparations at the turn of the century. Pills and powders prepared by midwives and practitioners from dried ovaries and testes were used against a wide variety of diseases. Women were treated with ovary preparations for all sorts of disorders, physical as well as mental, ascribed to malfunction of the ovaries. Elderly men were treated with testicular preparations to recover declining sexual and mental abilities. This popularity of testicular and ovarian preparations attracted a second actor to the stage: the pharmaceutical industry. Following the paramedical practice, the pharmaceutical companies also came under the spell of the glands. The manufacturing of extracts from animal organs offered a new and promising line of production. Pharmaceutical companies started producing ovarian and testicular preparations, with some success. At the turn of the century, the advertising pages of medical journals were full of recommendations for the prescription of these preparations under a wide variety of trade names, indicating a flourishing trade in 'biologicals'.<sup>14</sup>

Besides the gynaecologists and the pharmaceutical industry, laboratory scientists, in this period mainly physiologists, also gradually came under

the spell of the glands.<sup>15</sup> After the turn of the century, the laboratory of Edward Schäfer, professor of physiology at University College London, took up the study of the ovaries.<sup>16</sup> The physiologists were particularly interested in the study of the glands because the concept of hormones provided a new model for understanding the physiology of the body. In the first decade of this century, physiologists included the study of the ovaries and testes as a branch of general biology.<sup>17</sup> By this move, the traditional borders between two different groups of actors – the physiologists and the gynaecologists – changed dramatically. Before the turn of the century, the study of ovaries, particularly in relation to female disorders, had been the exclusive field of gynaecologists. With the introduction of the concept of sex hormones, laboratory scientists explicitly linked female disorders with laboratory practice, thus entering a domain that had traditionally been the reserve of gynaecologists. Whereas gynaecologists were particularly interested in the function of the ovaries to control all kind of disorders ascribed to ovarian malfunction, physiologists had a broader interest in the role of ovaries and testes in the development of the body.

Summarizing the situation at the beginning of this century, we can conclude that three groups of actors were interested and actively involved in research into the sex glands: the gynaecologists, the pharmaceutical industry and the laboratory scientists. It is also clear that the accessibility of research materials did not yet interfere with the relationship between these actors. Although interested in the same subject, the actors could operate quite independently from one another. In this period each actor had the techniques, as well as the research materials, required for research on sex glands at his or her disposal.

The techniques and research materials of the gynaecologists were provided in their clinical practice. Gynaecologists were already familiar with the surgical technique of castration, and the research materials could be obtained from their own patients. Since the 1870s, surgical operations for the removal of human ovaries had become common practice in gynaecology, and consequently gynaecologists had the necessary skills and easy access to the research materials required for their experiments.<sup>18</sup> Later, the placenta and animal ovaries were also used as research materials.<sup>19</sup>

The physiologists were able to perform their experiments in continuation of their tradition of laboratory practice, applying techniques and materials that came into general use in the last decades of the century. Of particular importance was the introduction of laboratory animals like guinea-pigs and rabbits, and somewhat later, mice and rats, which became

the major subjects in their experiments to study the role of the ovaries and testes.

The third actor in the emerging field of sex hormones found it somewhat more difficult to gain access to research materials.<sup>20</sup> The pharmaceutical industry had no tradition or practice to lean on, so it had to make other arrangements. To obtain the material they needed for the production of testicular and ovarian preparations, pharmaceutical companies entered into contracts with local slaughterhouses to guarantee a steady supply of animal glands – organic matter that was not used for the production of food.

In this early period, the activities of the three groups involved in research on sex hormones did not yet interfere with one another. Every individual in these groups interested in the subject of sex hormones could enter the field and perform experiments without assistance or interference from the other actors.

### **Capturing Each Others' Interest**

Although the actors involved in research on sex hormones focused on the same research object, their daily practices were not linked to one another. In spite of this relative independence, the relationships between the actors were not unproblematic. In fact, disputes arose among them, both between the gynaecologists and the pharmaceutical companies and between the physiologists and the gynaecologists.

In the 1910s, gynaecologists began to criticize the pharmaceutical industry for the production of ovarian preparations. Although there appeared many enthusiastic reports on the therapeutic effects of ovarian preparations in menstrual disorders, gynaecologists became sceptical about the quality of the commercial products. In clinical trials, gynaecologists compared the commercial preparations with their own extracts, and observed negative results for the former. Gynaecologists claimed that the powders and pills available in the drug trade did not contain the active substance from the ovaries. In addition to clinical trials, gynaecologists had developed a physiological test to evaluate the activity of ovarian preparations by measuring the growth of the uterus in experimental animals.<sup>21</sup> The criticism of gynaecologists was part of a growing professional concern about the quality of all types of drugs. In the 1910s, drug regulation gradually became institutionalized. In the US, the Congress had passed the Biologics Control Act (1902) and the Pure Food and Drug Act (1906). In 1905, the American Medical



Association established the Council on Pharmacy and Chemistry to set standards for drugs. In the Netherlands, the authorities installed the Governmental Institute for Pharmaco-Therapeutical Research (1920) in order to gain control over the quality of commercial pharmaceutical products. Following these drug regulations, the pharmaceutical industry laboured under more rigid constraints about the claims they could make.<sup>22</sup>

The critical approach of gynaecologists towards the pharmaceutical companies challenged them to improve the quality of their products.<sup>23</sup> The implicit message in this criticism was: if you want to make better products, you have to consult the gynaecologists; only the gynaecologists have the knowledge required to make effective preparations. Although gynaecologists succeeded in drawing the interest of the pharmaceutical companies to fundamental research on sex hormones, they subsequently could not prove their claim to be the real experts on this subject.

In the dispute over the quality of commercial preparations, the third actor began to criticize the expertise of gynaecologists. Laboratory scientists and gynaecologists could not agree about what would constitute sufficient evidence to demonstrate that extracts of ovaries and testes contained an active ingredient. The laboratory scientists criticized the gynaecologists for testing ovarian preparations in the clinic before their physiological and pharmacological effects were known. They argued that extracts should not be evaluated merely in terms of their therapeutic value, but should also be assessed with physiological tests.<sup>24</sup> The dispute over the appropriate methods of assaying sex hormones was part of a more general struggle between scientists and clinicians, which can be seen to characterize this period in medical history. The early decades of this century were characterized by a growing professionalization of the sciences, a process in which laboratory scientists presented themselves as the dominant profession among those, including clinicians, concerned with natural phenomena. By emphasizing the superiority of physiological methods over therapeutic test methods, laboratory scientists transferred the study of sex hormones from the domain of the clinic to the laboratory, thus defining the demarcation lines of their own profession. Physiologists began to develop biological assay systems for the evaluation of the active substances in ovarian and testicular preparations. In this quest, laboratory scientists used a great variety of physiological methods.<sup>25</sup>

Through this strategy, the laboratory scientists succeeded in developing a basis for their claim to provide the knowledge needed so badly by the pharmaceutical industry. In 1923, American laboratory scientists introduced a test that in their opinion was much better for the evaluation