

**Influences on Physics:**  
**Examining Early 20<sup>th</sup> Century German Scientists**

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**Abstract:** This thesis is written out of my love and passion for physics, Germany and history. I choose this research project because I really wanted to show the importance of understanding the scientist behind the equations and theorems. This paper is to show that the events coming out of World War 1 in Germany and into the second war had strong influence on the physicists and affected their choices and their work. I spent many hours researching these physicists and the events of the time. Most of my research comes from Paul Forman, who has applied the cultural history to science. The rest comes from books, articles from today and 1920s Germany, and even an interview with Werner Heisenberg. What I found most interesting in the end was that the proponents of the Deutsche Physik movement, also believed racial heritage affected a scientist's work as I also do. Perhaps the biggest difference between us though, is that I do not believe one's heritage makes his work wrong or right. Just merely that where one grew up affects, his values and thoughts. In the end, I just furthered my interest in the subject even more and hope next to look at influences on the scientists work during World War II.

# I. Introduction

Science is a collective effort of humans to describe the natural and physical universe, though this definition is extremely incomplete. Part of science is that it is and will always be a human endeavor; the scientist cannot be separated from his or her work. Commitments, beliefs, prior knowledge, training or experiences will influence science. Thus, the scientist cannot be separated from his or her work.

Perhaps a great place in history to look at the connection between scientists and their work is in the early 20<sup>th</sup> century Germany. There was a “remarkable paradox, where a place and period of deep hostility to physics and mathematics was also one of the most creative in the entire history of these enterprises (Forman Weimar 4). It was then that the connection between the environment and physics became visible to physicists. Physics in Germany coming out of World War I and up into World War II clearly demonstrates how much influence politics, religion and the economy had on physics and vice versa.

The theme of this thesis is to show how prominent scientists responded to the environment of the Third Reich. I have broken it up into five main parts; I feel had the greatest influence on the scientist. The first part is about the attitude of German and Allied scientists coming out of World War I and into the Weimar Republic. The second part is about the academics in Germany, the places of study, academic positions and funding. The third part is about deutsche Physik. The fourth part is about politics and the effects of the rise of National Socialism on physicists.

The fifth and last part, is about the physicists and how they dealt with these situations. I hope that when I conclude the reader has a greater understanding of how important the human factor is in understanding science and scientific progress. In hopes to provide the reader with examples of these influences, I have chose five physicists who were important figures of the time. It is through their stories that one can see “the *nature* of the response...to the circumstances” (Forman Weimar 4). First, there is Johannes Stark, who worked in experimental investigation and discovered the optical Doppler effect in canal rays in 1905 (Beyerchen 2). Stark became one of the leaders of the Deutsche Physik movement. Second, is Max Planck, who worked with blackbody radiation and quantum theory. “Planck’s success in physics, for which he is always thought he had no particular gift...came from a long absorption in the material and a slow maturing of ideas” (Heilbron 3). Third, is Max Born, who turned his back on Germany, “a homeland that no longer desired his services” (Beyerchen 21). His work included quantum mechanics and solid-state physics. Fourth, is Werner Heisenberg, born in 1901, he is the youngest of the physicists presented here. He worked in quantum theory and later nuclear physics. Last, is Philipp Lenard, who also was a leader of the deutsche Physik movement and spent many years prior working with cathode rays.

I have chosen to not include Albert Einstein as a main figure in my thesis. While Einstein is an important figure of this time and a complete analysis cannot be

done without regard to him, I have chosen to focus on other scientists, whose stories are lesser known.

## **II. World War I and Weimar Republic**

The pain of the Great Depression, the strict conditions of the Treaty of Versailles and a long succession of unstable governments, the people of Germany were in a crisis. Many people were dead, including physicists who fought in the war. The United States was rising as an economic power, while Europe declined. Changes in political and social thought happened in parallel with revolutions in scientific thought. The attitude toward German scientist was harsh and they were excluded from the internationalism of science. German physicists felt a stronger sense of patriotism and as the country started to reform so did physics.

### **Attitude of German Physicists**

The Germans never thought they were going to lose the war. In the summer of 1918, “the German physical scientists, like the rest of German public, continued to look forward with confidence and satisfaction to a victorious conclusion of war” (Forman Weimar 8). They were looking forward to public esteem and academic prestige; the scientists “felt self-confidence and self satisfaction due to their contributions to Germany’s military” (Forman Weimar 8). Germany had built its greatness on the military and science, but when the “victorious end” turned to

defeat, the scientist faced a dramatic change in public values and thus altered value of their field.

### **Attitude toward German Physicists**

Communications were blocked during the war and when they open after German scientists were excluded from all internationalism. “Three fourths of the international scientific meetings not held in Germany or Austria between 1920 and 1924 excluded” German scientists (Heilbron 102). Part of science is sharing what you have learned with others, but they were not allowed. “Allied scientists constituted an important precondition to their formation of a comprehensive and exclusionist international scientific organization at the end of the war- the International Research Council” (Forman Scientific 157-8). German groups and societies lost foreign members and German publications lost articles and subscriptions. All this hurt German science, making it harder to progress and crushing the spirits of the scientists.

### **Need for Reform in German Science**

Science is a common driving force for research and the human urge to know everything. German physicists had a “hunger for wholeness” and a need to show the world they could be a contributing member of society (Forman Weimar 16). Paul Forman who has written many papers on the subject of crisis in Germany during the 20<sup>th</sup> century believes the reconstruction of science was a response to the negative prestige after the war (7). The values and mood of the environment was changing



and with it so did many German physicists. With political and military power no longer existing, science became the Kulturträger, or the bearer of culture. It could restore national dignity and international cultural policy, and with this came the new science of quantum mechanics.

Up until now, there was only the mechanical view, which said the universe was governed by a specific set of rules, yet quantum mechanics seemed to deny this. Despite all the difficulties and miserable living conditions, creativity was at a high. New ways of thinking led to looking at light in new ways. One must now look to the new government of Germany and the Weimar Republic as to what outside ideas influenced physics.

### **Weimar Republic (1918-1933)**

The first four years of the Weimar Republic were years of crisis. The government was under attack, the economy in hyperinflation. The inflation “destroyed endowments of scientific institutions and made it impossible to purchase equipment or even journals from abroad and expensive to buy at home” (Heilbron 89). Many schools were in rubble from the bombings and admittance into colleges required the prospective students to clear away debris. Many scholars viewed the Weimar government with icy reserve: “they were willing to serve the German State, but not the Social Democrats” (Beyerchen 4). The physicists saw the politicians and their social views being below their rigid and exact views, though their own stances were just as radical.

In 1923, Germany became more stable. Weimar became a symbol of liberalism, socialism and cosmopolitanism. The dominant tendency in the Weimar academic world was “a neo-romantic, existentialist “philosophy of life”...characterized by antagonism toward analytical rationality” (Forman Weimar 4). It was a period of major cultural revival. The cabaret scene became popular, women became more daring, wearing make up and cutting their hair short. Germany was becoming Americanized. Most German academics did not recognize the Weimar regime as “the legitimate voice of the German nation” (Forman Scientific 176). Those physicists who rejected Weimar also rejected relativity and quantum mechanics.

At the start of the thirties, Germany became politically unstable. Adolf Hitler was gaining popularity and Stark and Lenard were using him to promote their Deutsche Physik. There was a struggle against English and American influence on the German culture and physics (Forman Scientific 157). German professionals even considered England to be their greatest foe (Beyerchen 29).

### **III. Academic Ideology**

As it has been illustrated, academic Germans did not mix politics with science, yet a physicist’s scientific views often paralleled with his political views. It was seen in the university structure, in academic appointments, organization of associations, journals and research institutes. Education in Germany during the early twentieth

century, entailed “the notion of character and personality formation within a cultural environment which stressed duty, adherence to principle and a lofty concern for the *geistig* (inner or spiritual) values of life” and thus the *Kulturträger* (bearer of culture) (Beyerchen 2). Physicists were divided between two main groups, the experimentalists and the theorists. Their environment was hostile and difficult, yet against all odds, German physicists set some new and exciting areas in science.

### **Places of Study**

In German, three cities became the centers of the new theories of modern physics. Many scientists gathered in Berlin, where it became the “stronghold of German physics” (Beyerchen 8). Here is where Max Planck, Max von Laue, Albert Einstein, Walther Nernst, Erwin Schrödinger, Gustav Hertz and Richard Becker studied and worked. Berlin was also the center of the Weimar culture where many liberal intellectuals gathered. Because all these “successful”, “flavored” and “influential” academics were those in Berlin, it became the focus of hatred (Forman Financial 55). In the 90 years prior to 1922, only three of six professors of experimental physics had been Jewish. After 1922, the proportion of Jews was particularly high and accusations of “Jewish intellectualism”, haughtiness, arrogance and monopoly of limelight was made against Berlin (Forman Financial 56). Still the degree of work put out of this city was high.

The other centers, though much smaller, no less important, were Göttingen and München. Göttingen was a much smaller college town and was a “symbol of the beautiful years” (Jungk 10). Mathematicians were found in great number here and they worked closely with the physicists. Many were Jewish and severely effected by the Nazi dismissal of “non-Aryans” in 1933. Though few Jews were hired in München, it was the “seedbed of counter-revolution and anti-Semitism in the Weimar Years” (Beyerchen 9). It was here, that Sommerfeld held a position and by 1928, “nearly a third of all full professors of theoretical physics in the German speaking world were Sommerfeld pupils” (Beyerchen 9). While he knew of quantum theory’s importance, his goal was teaching students to become physicists. The effect of the rise of National Socialism was felt most here by the politically pressured academic appointments.

### **Academic Positions**

All sciences were hurt by the rise of National Socialism, but physics has proved to be one of the most heavily affected. By 1935, one out of five scientists and one out of four physicists had been driven out of their positions (Beyerchen 40). Though not all were forced out because of the dismissal law, some left because their morals could not stand for what was going on, others found better positions in different countries and some left to pursue other new political interests. Perhaps if the Nobel Prize can be used to measure quality, twenty Nobel winners were driven from their posts, then Germany lost many highly talented scientists. The main

explanation is that there were many talented Jewish researchers in physics. It was not a coincidence that many Jews found openings in physics. New academic positions had been created in theoretical physics because of all the work being done in quantum theory. Also, the two men whose advice on filling positions was Planck and Sommerfeld, who never hesitated to promote a Jew (Beyerchen 49).

### **Academic Funding**

The economic situation after the war had a great impact on the personal welfare and research of German scientists. “No more than 100-200,000 marks were even potentially divertible annually to the cost of research as such from the budgets of the physics institutes of the universities and technological institutes in the late 1920s (Forman Financial 41). Funds were no longer given “on faith” to the director to be distributed on his discretion; they were given specifically for research and only the top priorities.

New institutions were created to help support German science. The two largest were the Notgemeinschaft der deutschen Wissenschaften (NGW) and the Helmholtz-Gesellschaft zur Förderung der physikalischen Forschung (Forman Financial 39). The NGW was the dominant source of funds during Weimar. Planck was one of the founding members and held a presidential position for many years, also Stark was president from 1934-36 (Heilbron 45). The difference between the two institutions was the NGW was a self-governing union of institutions of research and higher education while the Helmholtz-Gesellschaft was an association of large

industrial firms supplying funds. The principle contributors to the Helmholtz-Gesellschaft were the Rhenish-Westphalian coal, iron and steel firms and the banks associated with them. German industrialist had profited during the first war and benefited from the inflation and could give generously to science (Forman Financial 46). While there was a traditional distaste for businessman and the Americanization of education, the academics recognized how much their outlooks matched the industrialists. The industrial contributors' views were influenced by the physicists' view of nature and while the funds were being supplied, they influenced what the physics researched.

#### **IV. Deutsche Physik**

How, it is often asked, could able and well-established scientists declare allegiance to National Socialism? The answer to this question is more than a hatred for the Jewish. Deutsche Physik or Aryan physics was not really a science but politics. It was created on the personalities of Lenard and Stark, whose anger came from an opposition to relativity and quantum mechanics. They were able to gather a following because they were great physicists who had great influence and they were not the only ones having trouble with the extensive mathematical calculation relativity and quantum mechanics required.

## **Views on Physics**

The main standing of this group was what they did not believe than what they did. There were many fractions on the proper role of physics. Generally, they believed in a “mechanical, yet organic, nonmaterialistic universe in which discovery could only come through observation and experiment” and that “the racial heritage of an observer directly affected the perspective of his work” (Beyerchen 123). This was physics free from highly abstract and mathematical theory.

The group however disagreed on an important point, the role of the technological application of physics. Lenard and his followers were against modern tradition, while on the other hand; Stark and others were in favor of technology.

Of course, deutsche Physik is best known for their racist views. Lenard, Stark and their followers believed the very concept of science had been created by the Nordic race. The Jewish method of doing science was “alien to nature and science”. Instead of observation, the Jew favored theory and abstraction and Einstein was the perfect example of this theory. The Jew also used complicated mathematics to prove their theories instead of experimental observations. While, the Aryan was racially conditioned to observe nature, formulate without promoting one is self and give them up when new evidence becomes available (Beyerchen 133).

## **Why Deutsche Physik failed**

Besides, perhaps the most obvious reason Deutsche Physik failed was because National Socialism failed. However, it was falling apart before the Nazis

even started having problems. By 1939, the physics in Germany was suffering terribly and the physicists, in and out of the party, decided to do something about it. When the physicists were finally made to discuss physics and not politics, they could not deny theoretical physics. It was never stopped from being taught at the universities (Beyerchen 181). The Deutsche Physik was so fractured by their different beliefs; their squabbles took away their strength. In the end, it met with disaster because of bad physics and bad politics. The members of the movement had very little support from the Nazis (Walker 64). Hitler had very little interest in intellectuals and technology before the second war. He never took a direct hand in the physics community.

Perhaps, if Lenard and Stark had really thought about it, they had alienated themselves and declared relativity and quantum mechanics to be Aryan they might have prevailed. Deutsche Physik could not provide the terrible new weapons; only modern physics could do that. It was ideology versus power. Yet, at a time when there was so much resistance to a science it still managed to make leaps in understanding and achievement.

## **V. Politics and National Socialism**

The events that happened in Germany in the 1930s are very well known. There is much to be said about social group theory and why the Nazis gained so



much power so quickly. This thesis is not about the politics or whether they were right or wrong, but how the government's choices and actions affected physicists.

### **New Policy**

One of the basic goals of National Socialism was to legalize anti-Semitism. In the 1920s, the party had already decided that only the Volksgenossen (racial comrades) could be citizens and only citizens could hold public office. Hitler never intended to damage science, which was just a side effect of getting Jews and other non-supporters out of positions of power. The implication of the Civil Service Law affected the entire academic community. However, it was not clear at first the Nazi government was going to force the emigration of Germany's Jews.

### **Effect on Physicists in Germany**

Many physicists had to make a choice when the dismissal policy came. They were left with few choices. They could stay in Germany, the country they grew up in and loved, and they could either keep quiet and passive or they could fight as aggressively as they knew how. They also could leave their home country to emigrate. There was another choice also available to them, they could join the Nazis and work with them. Not every scientist was given a choice either. The loss of many of the scientists leaving was not even apparent at the time. Many of them were young and their talents still had much room to grow.

## **Effect on Physics in Germany**

Part of what characterized Germany during this time is the brain drain. There is no doubt how hard science National Socialism hit, and that physics was one of the most heavily affected. It has already been said that the discipline lost a quarter of their personnel, unfortunately it is impossible to find detailed figures. The number of students lost will never be known. The open, vacated positions were so serious, there was talk of creating a Ph.D. program in industrial laboratories (Beyerchen 200).

Through all this, Germany still thought their science was the best in the world. They never feared the success of an American or British project. However, the refugees were the driving force behind the atomic bomb. Still National Socialism was not responsible for the decline of German physics. While the dismissal did indeed handicap the continuation of high quality work in Germany, the Nazis only obscured an already deteriorating situation.

## **VI. The Scientists**

Here are just five short biographies of five important German scientists who all dealt with the previous situations differently.

### **Johannes Stark**

World War I increased Stark's sense of nationalism, but also caused him to view Einstein, who he once respected and encouraged, with disfavor for his open

pacifism and internationalism. Stark did not fight in the war, instead he “made his greatest discovery, the splitting of spectral lines in an electric field”, for which he received the Nobel Prize for in 1919 (Beyerchen 105). It was in these years that Arnold Sommerfeld applied Neil Borh’s electron theory to the Stark effect and Stark’s distaste for the new theory grew. He was unwilling to abandon his experiments for theory. Stark became more isolated from the physics community.

Stark’s fear of the Weimar government controlling academia led him outside of physics to interest-group politics to protect his profession from government interference. His alienation led him to feel victimized and he found a friend in Lenard. Stark believing he had no future in academia, announced allegiance to Hitler. He quickly aligned himself with other Nazis and used their increasing political advancement for his own personal agenda. Stark announced a desire to become the dictator of physics in Germany and control the scientific periodicals (Beyerchen 116). For Stark, *Deutsche Physik* was a weapon to attack those who had hurt him.

### **Max Planck**

Planck and his family suffered greatly during the first war. Many lives were lost and by the war increase Planck’s nationalism and he “rejoiced in the patriotic surge of the fall of 1914” (Heilbron 69). When the war ended he did not let the isolation of his country go without a fight. Planck’s slogan was to “preserve and continue working” and he wanted his colleagues to follow along. Planck believed

that science stood above politics and said, “Obviously we can do nothing better toward [improving international scientific relations] than to work hard at science and so try to raise the value of exchanges with us” (Heilbron 93). He felt that the new quantum theory was a great way for German physicists to demonstrate their worth to the rest of the world and if they were to ignore them like Stark, Germany would fall behind other countries.

By 1933, Planck was 75 years old and his perspective of age must have increased his desires to avoid action. He was able to remain with the Helmholtz-Gesellschaft, now the Kaiser-Weilheim Gesellschaft (KWG), for many years. Unlike many organizations, the KWG was never aligned with the government and never suffered. Through this organization of Planck’s he was able to open the new institute of the Kaiser Wilhelm Institute for Physics (Heilbron 55). The KWG was also able to keep some work distributed and continue research. Planck’s understanding of the importance of education outweighed his need for professional prestige and helped many other scientists.

### **Max Born**

In 1921, Born became the ordinaries professor of theoretical physics and Director of the Institute of Theoretical Physics at Göttingen. Born supported Einstein openly, though it was all talk. When he had the opportunity to bring a friend to a position in Götteningen, he decided he could not face the fight (Beyerchen 20). Perhaps he chose not to fight because of his failing health. When the

government tried to save funds by dismissing assistants, Born led a movement for the natural science faculty to instead cut their income (Beyerchen 20).

As Born's health continued to fail, he no longer wished to live in Germany when the Nazis rose to power. While it can be seen from the Born-Einstein letters, that he agreed with Einstein, his aversion for public debate was strong.

### **Werner Heisenberg**

During the Weimar Republic, Heisenberg was still studying at university, studying under Sommerfeld, Wilhelm Wein and later Born. He was also a part of the German Youth Movement and German Scout. When he first met Sommerfeld and Wolfgang Pauli, they had a profound effect on him. His interests switched from mathematics to physics. Heisenberg said Pauli would frequently tell him, "You are a complete fool" and that it helped a lot in developing his ideas (Interview). He spent most of his time out of politics and studying physics and quantum theory.

There has been much made of the fact the Deutsche Physik movement was able to discredit Heisenberg to block him from succeeding Sommerfeld. He was attacked by Stark as a "white Jew" and "Jewish in character" in *Das Schwarze Korps*, a SS newspaper (Walker 65). Heisenberg was disappointed that we had to focus so much political things when there were such exciting things going on in physics. He had no desire to leave Germany, but he also did not want to live as a second-class citizen, so he fought strategically. In order to live how he wanted he had to work with men such as Heinrich Himmler in order to further his career. By just the nature

of the Third Reich, there could not be scientists who stood aloof from politics of the state.

Heisenberg had to disown Einstein's contribution to modern physics, separating physics from Jews at all costs. Still he was able to teach modern physics, he just had to leave parts out, the parts that make science science, the human endeavor. Heisenberg made deals and when he was finally called to the appointment at the Kaiser Wilhelm Institute, it was a fulfillment of a promise from Himmler (Walker 77). It was not Heisenberg's professional competence as to why he received the position.

### **Philipp Lenard**

Lenard faced a very difficult time during the twenties. His son and last of the family name died in February 1922, partially due to malnutrition during the blockade (Beyerchen 93). Another hard hit was the gold he had traded for government bonds during the war were no worthless. He spent most of his time fighting Einstein and his work. He issued a "word of warning" published at the Century Celebration at the Natural Researchers and Physicians convention in Leipzig (Beyerchen 92). This marked a milestone in Lenard's life. From this point on his anti-Semitic views were clear and put into two of his works; *Grosse Naturforscher* (1929) and *Deutsche Physik* (1936-37). Lenard declared his allegiance with Hitler in 1923 before it was fashionable to do so. Though, still the scientist he could not overcome his distaste to join any political part until 1937 (Beyerchen 97).

Lenard's reasons for his desire of a pure Deutsche Physik were different than Stark's. After Lenard had received his doctorate, he left for England at 28 years old. He had taught himself English by reading Darwin's *Origin of Species* (Philipp 60). He soon found England not to his taste. They were "uncongenial and unreceptive...and lacked great personalities of the stature of those of the past (Beyerchen 79). His hatred for the English increased when J. J. Thomson published the first article on the photoelectric effect, in which Lenard claimed Thomson had copied his results that Lenard had shared with Thomson (Beyerchen 81).

A few years after this Lenard was unable to work as he suffered from an illness and had to have surgery. When he was able to work again, he was very behind in forefront of physical discoveries. He had trouble understanding and following the work of others. Lenard fell especially behind in theoretical physics and found the math to be too difficult. The fact that Thomson had come from a mathematical background reinforced his hatred toward the English and theoretical physics. Lenard soon began linking modern physics with all he hated.

## **VII. Conclusion**

When faced with times of great strain, difficult choices must be made. A person's values and experiences shape what path he takes. This is true for every man, even scientists. Perhaps, early 20<sup>th</sup> century Germany is one of the clearest examples of making choices. Stark, Planck, Born, Heisenberg and Lenard were all

working physicists in the 1920s, but they all made different choices. The environment they lived in was the same for all of them, but it was things such as, their political standings, their religion, their academic standing and their academic understanding that affected them all differently. In order to truly understand physics, or any science, it must be looked at as a complete picture. The path a scientist took to reach his or her groundbreaking discovery is just as important as the discovery. Without it, one merely has statements, not science. Hans Reichenbach explained, “the most important thing one can say about [doing physics] is that it is a need, that it grows up out of the human being just like a wish to live or to play, or to form a community with others” (Forman Weimar 45).



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