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How Political Repression Stifled the Nascent Foundations of Heredity Research before Mendel in Central European Sheep Breeding Societies

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Abstract: The nineteenth century was a time of great economic, social, and political change. The population of a modernizing Europe began demanding more freedom, which in turn propelled the ongoing discussion on the philosophy of nature. This spurred on Central European sheep breeders to debate the deepest secrets of nature: the transmission of traits from one generation to another. Scholarly questions of heredity were profoundly entwined with philosophy and politics when particular awareness of "the genetic laws of nature" claimed natural equality. The realization that the same rules of inheritance may apply to all living beings frightened both the absolutist political power and the divided society of the day. Many were not prepared to separate religious questions from novel natural phenomena. Open-minded breeders put their knowledge into practice right away to create sheep with better wool traits through inbreeding and artificial selection. This was viewed, however, as the artificial modification of nature operating against the cultural and religious norms of the day. Liberal attempts caught the attention of the secret police and, consequently, the aspirations of scholars were suppressed by political will during approximately 1820–1850.

Keywords: artificial selection; history of heredity; learned societies; sheep breeding; war

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1. Introduction

Science, stemming from the Latin word *"scientia"* for "knowledge", usually refers to the great enterprise of observing, identifying, describing and explaining phenomena through experimental investigation [1] (p. 49–71). This characterizes science as an outlook based on empirical knowledge that is derived from sensory experiences, particularly by observation and experimentation [2] (p. 129–138). To quote Carl Sagan along these lines: *"Science is more than a body of knowledge. It is a way of thinking; a way of skeptically interrogating the universe with a fine understanding of human fallibility. If we are not able to ask skeptical questions, to interrogate those who tell us that something is true, to be skeptical of those in authority, then, we are up for grabs for the next charlatan (political or religious) who comes rambling along"* [3] (p. 143).

Experimentation is often incompatible with the surrounding social environment [4]. For present-day historians of science, the fact that scientists and their work are intimately intertwined with political forces is neither scandalous nor surprising [5]. After all, the entire scientific endeavor cannot happen without society's blessing. Science is not an isolated cultural activity but actively shapes politics and society, as well as actively being

shaped by them [6]. Norms and values inform research and scientists are themselves acknowledged as human beings too, which constitutes the legacy of decades of research in the history, philosophy, anthropology, and sociology of science [6–8]. Even something as seemingly innocuous as secondary science education teaches students not only facts, but also about what sorts of facts are worth knowing [9] (p. 135). Furthermore, it teaches which scientists we should remember and with what sentiments we should remember them. This is especially true for genetics, which has a crooked history with forgotten or overlooked scholars. However, important changes are taking place in how undergraduate genetics courses are taught largely in response to recent developments [10].

Stetten [11] also pointed to the effect of assaults upon the freedom of enquiry and the pursuit of knowledge, which have been the stock trade of all but most benign dictatorships. The best example as to how politics can corrupt and undermine the rational bases of science can be seen through Lysenkoism [12–15]. Under Stalin's rule, genuine Mendelian genetics was banned, and a soviet pseudoscientific discipline was favored, which had devastating consequences, leading to the death of millions in the Communist Bloc [16,17]. Lysenko's signal achievement had been to persuade Joseph Stalin (1878–1953), and after him also Nikita Khrushchev (1894–1971), that the heredity of acquired characteristics [18] offered proof of the Marxist concept of societal evolution [19,20]. Indeed, one of the authors of this paper stands as witness to the experiences from that Stalinist era. Unfortunately, genetics was born in Central Europe and important historical research on its development was hindered, including learning about Mendel's personality and the background of his experiments. Progress was frustrated first by the Nazi occupation [21–23] and later by the communist revolution [24]. In this regard, we should not forget about H. J. Muller (1890–1967) who spoke out on numerous occasions about the uses and abuses of genetics in society [25].

Behind the Iron Curtain, Vítězslav Orel (1926–2015) made a strong contribution to the rehabilitation of genetics, generally, by championing the work of Johann Gregor Mendel (1822–1884). His work was beset by the wider problems associated with Mendel's recognition in the Communist Bloc, and by the way in which narratives of the history of science were co-opted into the service of Cold War and post-Cold War political agendas [26]. Together with Jaroslav Kříženecký (1896–1964), in 1962 he cofounded the Mendelianum in Brno (Czech Republic), which for decades has served as an intellectual bridge between the East and West. Orel's involvement with this institution exposed him to dangers both during and after the Cold War [26]. Kříženecký was imprisoned by the Gestapo twice and once by the communists for promoting Mendelian genetics, while Orel was termed as an "individualist" and was forced to work at a poultry farm due to his connections to Kříženecký. The Iron Curtain is long gone, but puzzling together the early history of heredity research is still actively ongoing today (see [27] (p. 85)), revealing that the malevolent shadow of repressive politics has already surrounded the cradle of pre-Mendelian corpuscular genetics—a time when animal and plant breeders of the Habsburg Empire debated among themselves over the effect of artificial selection (*künstliche Zuchtwahl*) on any organism manifested in inherent changes among generation guided by the "genetic force (*genetische Kraft*)" [28] (p. 181–183); [29]. The term "artificial selection" coined by Christian Carl André (hereafter C.C. André) in 1812 is reminiscent of the expression "natural selection" introduced much later by Charles Darwin (1809–1882). The connection between Darwin and sheep breeders was investigated by Wood [30].

2. Creative Philanthropy: Setting the Stage for Industrial and Scientific Revolution

The origin and development of scientific sheep breeding in Moravia and the promotion of natural sciences in Brno (Brno) through private learned societies can be traced back to Christian Carl André (1763–1831) (Figure 1). André was a prominent figure in Moravia, exhibiting a keen perception of and support for elements of early liberalism [31] (p. 617–631). André was born and raised in Hildburghausen, Thuringia. He studied at the University of Jena and in 1782, he established an educational institution in Arolsen where

he worked as a teacher. In 1785 he was invited to teach in the prestigious Schnepfenthal Institution (*Salzmannschule Schnepfenthal*) in the district of Gotha (Germany)—an institute founded in 1784 by the educational reformer Christian Gotthilf Salzmann (1744–1811). Salzmann and André advocated philanthropic pedagogy or *Philanthropismus* and founded girls' schools that encouraged students to be open-minded and to acquire knowledge by directly observing nature. As part of the curriculum students were thought to exercise their minds and their body equally. Schnepfenthal was the first institution to incorporate natural sciences into the general education curriculum. André was well versed in different scientific disciplines, including botany, zoology, and economics [32] (p. 47–56). He showed a particular interest in mineralogy and became a follower of "the father of German geology," Abraham Gottlob Werner (1749–1817). In 1798, André received an invitation from Victor Heinrich Riecke (1759–1830) to become a teacher in Brno, and he brought with him his extensive natural science collections, including a large cabinet of mineralogical collections [33] (p. 31). He took part in the organization and foundation of several private learned societies with Riecke and other prominent figures. These figures included, Ignaz Mehoffer (1747–1807), Count Johann Nepomuk Mittrovský (1757–1799), and Heindrich Friedrich Hopf (1754–1825), who were also dedicated to the scientific and intellectual developments in Brno. Moving from Saxony to Brno, André met the broadly educated Count Hugo Franz Salm-Reifferscheidt (1776–1836) (Figure 2), Moravia's leading industrialist.

Figure 1. Portrait of the agricultural expert and journalist Christian Carl André in 1819, engraving by Blasius Höfel after Ant. Richter. Printed from a negative in the archive of the Mendelianum in Brno.

Figure 2. Portrait of the philanthropic count Hugo Salm leading figure of the agricultural and industrial revolution in Brno. Courtesy of the National Heritage Institute, Czech Republic catalogue number: RA8367.

Salm had a fine private library of 59,000 volumes, rich in works on natural science and technical subjects, but also on art history, the occult, alchemy, and freemasonry, all housed in his castle in Rájec-Jestřebí (Raitz-Jestreb) not far from Brno. Among other things, he introduced a smallpox vaccine in Austria and Moravia [34] (p. 233–235), based on the methods of enlightened empiricism of the early 19th century (see [35]). Salm also conducted chemical experiments in his castle's laboratory, dabbled in the field of metallurgy, and launched expeditions to the Macocha Abyss in the Moravian Karst [36] (p. 6). In 1798, he went to Berlin to study the latest methods for distilling sugar from beetroots, then worked as a miner in Příbram, Bohemia (nowadays the Czech Republic). Determined to raise the level of local wool production, Salm—disguised as a laborer—worked in several English factories, where he stole the designs of modern textile machines and then smuggled them into Moravia [34] (p. 233–235); [37] (p. 191).

As part of the Habsburg Empire, Brno gradually emerged as the 'Austrian Manchester' and Salm became a wealthy benefactor of natural sciences. He needed an economic advisor, a role in which André successfully served. Moreover, serving in this role had provided André with enough of a salary to pursue his own ambitious scientific visions. As a leading center for wool production, Brno became involved in the need of fine wool and increased demand for agricultural products due to the outbreak of the Napoleonic Wars (1803–1815). The Habsburg Empire partook in all alliances organized against the French Revolution and Napoleon Bonaparte (1769–1821). Its aristocracy voted for new taxes and the army recruited millions of soldiers, with tens of thousands dying in European battlefields. With the surge in prices for grain and wool, producers and merchants benefitted. With scarce resources to finance its increasing expenditures, the monarchy supported activities aimed at producing larger volumes of wool and cereals at lower prices.

Interest in knowledge about the improvement of fine wool grew among the members of private learned societies in Brno, mainly composed of factory owners, aristocratic improvers, intellectuals, animal breeders, and natural scientists. Working together, they

were interested in producing large quantities of fine wool in a short time. This started with the establishment of the 'Royal and Imperial Moravia-Silesian Association for the Furtherance of Agriculture, Natural Science and Knowledge of the Country' Moravian Agricultural Society (MAS)' generally known as *Ackerbaugesellschaft* in 1806. André said the following at the opening:

> "We are simultaneously establishing an academy of science and an economic society. We wish to arrange our experiments methodically, and not only according to sense and experience; we wish to carry out research, examination, instruction, and improvement on the basis of the clarified principles of the cost-effective subsidiary science. Without science it is impossible to achieve any progress [. . .] it may take centuries for works to emerge from our circle that are capable of earning the astonishment of the cultural world, and its gratitude for their public value. Whether today or tomorrow, we are perhaps providing indispensable elements without even a hint of their future impact". [38] (p. 93–111)

In this stimulating social environment, André grasped that a great discovery was about to be made. A detailed description of the scientific milieu in Brno can be found in Orel [39] and Poczai [40]. However, it was only in 1814 when the branch of the *Ackerbaugesellschaft* specifically tasked to investigate the problems of heredity was created, usually known as the Sheep Breeders' Society (SBS) (*Schafzüchtervereinigung*). Inbreeding methods, developed by Robert Bakewell (1725–1795), were also transferred to the Habsburg monarchy by Ferdinand Geisslern (1751–1824) and other members of SBS who visited England. Soon this society became an important melting pot creating a multicultural and interdisciplinary scientific community, which shaped pre-Mendelian heredity research [41]. Sheep breeders, factory owners, businessmen, economists, and academics in Brno—united by their common interest in wool—began discussing how they might increase production and quality [42]; [43] (p. 57–70). They were seeking a scientific basis for breeding by drawing knowledge from several fields to unify them into one interdisciplinary study.

Their prestigious scientific journal, *Economic News and Announcements* (*Oekonomische Neuigkeiten und Verhandlungen*, ONV) was widely distributed in the Habsburg Empire. The journal published cutting-edge research and included various disciplines of animal and plant breeding from practical advice and theoretical innovations to depicting new sheep breeds (Figure 3) and announcing plans for revolutionary machines. Seeking answers to practical problems, they began to ask basic questions about heredity, probing a subject about which very little was known. Members attempted to define a framework of underlying generalizations and explanations to underpin the new empirically developed procedures [44].

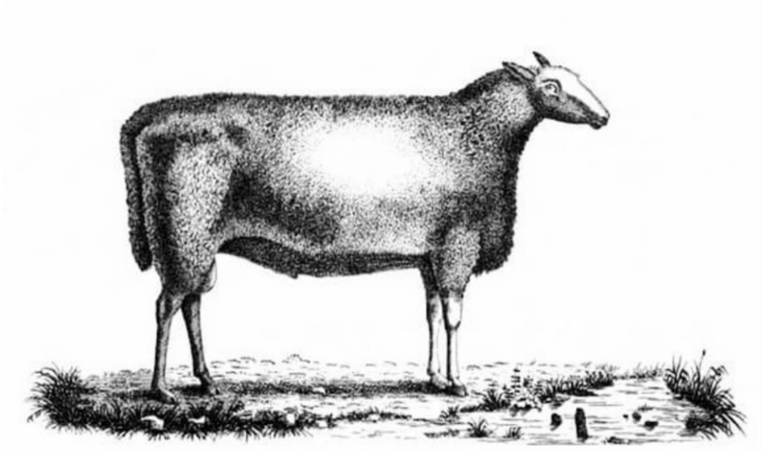

Figure 3. A freshly shorn Dishley ram from ONV 1825 Nr.45. Moravian breeders regarded Robert Bakewell's sheep race as an example applying inbreeding.

These debates in Brno during the period 1816–20 turned breeding experiments into a body of timeless theory of heredity and reached their peak with the paper written by Count Imre Festetics [45] entitled '*About Inbreeding*' (*Über Inzucht*). By summarizing the results of a series of lasting and elegant breeding experiments, Festetics formulated 'the genetic laws of nature' (*die genetischen Gesetze der Natur*). These empirical laws stated that the same hereditary laws apply to all living beings, and were carefully derived from his experiences and observations, when even basic biological mechanisms of reproduction were not understood [46]. Experimental procedures were omitted, and the application of mathematical models in search of heredity was not yet conceived, rather just intuited by Festetics [47], as he said on a meeting that took place on 5 May 1819: "*I believe in the beginning of a new epoch of scientific breeding defined with mathematical precision*" [48]. In responding to C.C. André's invitation in 1819, Festetics (Figure 4) provided, with his strictly empirical approach, an inspirational stimulus not only for his contemporaries but for future SBS members in their search for the truth about heredity based on the evidence of their own personal experiences of sheep breeding [49].

Figure 4. Imre Festetics lived in the town of Kőszeg, Hungary in the castle displayed on the photograph. From his estates he travelled with his sheep to the meetings of SBS in Brno yearly since 1814. Photo by Bence Gaál, courtesy of the Institute of Advanced Studies Kőszeg (iASK).

Later on, important scientific figures in Brno, such as Johann Karl Nestler (1783–1842) began lecturing about heredity (*Vererbung*) and how the inheritance capacity (*Vererbungsfähigkeit*) of sheep can be studied [50]. Nestler believed in blending inheritance, which was a commonly held view at the time, and he understood the transmission of traits in a mechanistic way, as defined by Blumenbach's formative force (*nisus formativus*). However, some members started to call this the "genetic force", a term derived from contemporary natural historical knowledge and German nature philosophy (*Naturphilosophie*), which they believed is the strongest cause for the form of sheep. For instance, J.M. Ehrenfels:

> "Climate, nutrition and generation remain the levers of Nature in the formation of matter. In the interaction of these three potentials, generation, the genetic force is the most powerful". [51] (p. 137)

At the meeting in 1836, Bartenstein presented an entirely new view on the "genetic force", which was "possessed by any particular individual" and tried to define it more closely by adding the idea that an individual's capacity to transmit its traits is necessarily

associated with any other superior quality [52]. The first of Festetics' genetic laws associated heredity with a healthy and robust constitution.

One year later the newly appointed Augustinian abbot of the St. Thomas abbey Cyrill Franz Napp (1792–1867) reminded the members that "the debate has completely deviated from the proper theme of heredity [. . .] the question should be: 'what is inherited and how?'" [53]. With this statement he formulated a research question, which later motivated Gregor Mendel in his experiments with peas and hawkweed [54–60]. Towards the end of 1837, Nestler published a paper "*Heredity in Sheep Breeding*" in which he wrote:

> "The terms species and race in the animal kingdom correspond precisely with the term species and variety in the plant kingdom. Only Nature produces, through forces beyond the hand of Man, under constant environmental conditions, natural species with undoubted constancy. Man, however, produces in the manner of the forces of Nature, in the reproductive process and formation of organic bodies, modified deviations. From the moment of their origin such deviations have the chance of increasing or disappearing in succeeding generations according to their inheritance". [61] (p. 281–286)

Both Nestler and Napp supported inbreeding tracing back to Bakewell and stressed by Festetics. They were certain that rigorous progeny testing, coupled with stringent selection of individual traits should be carried out to make inheritance more certain. However, members of SBS were reluctant to discuss the topic and they thought inbreeding is not even worth discussing. At the 20th anniversary of Festetics' paper, Nestler published a paper with the same title "*About Inbreeding*" (*Über Inzucht*), where he tried to convince the members of SBS to apply inbreeding in the investigation of the "genetic force" [62]. Nestler's death in 1841 left Franz Diebl (1770–1859) and Napp to encourage the practice and to seek further knowledge of heredity and inbreeding from the breeders' experiences [63].

In contrast to Nestler, Diebl concentrated on plant breeding and stressed the importance of pairing individual plants with different traits to create more productive varieties and he recognized that peas and beans are particularly suitable for inbreeding studies [64]. Diebl [65] published a new book in 1844 entitled "*The Breeding of Fruit Trees, Vines and Forest Trees*" and an enthusiastic student called Johann Gregor Mendel (1822–1884) attended to his lectures and did well in the examinations. In 1845, a new Natural Science Section (NSS) was established within the MAS similar to the sheep breeding section (SBS) composed of members who were not interested in animal and plant breeding. Members including Mendel and E. Festetics met separately and paid attention to technical problems. In 1861, the NSS became independent from the MAS, however E. Festetics did not live long enough to see this as he passed away in 1847. At the meetings, NSS members reported their observations on plant hybrids in nature but only Mendel investigated this topic experimentally. Mendel kept his membership of MAS but in 1866 he chose to publish with the politically more progressive NSS [63].

Each of the three figures, Nestler, Napp and Diebl, played a vital part in promoting the growth of knowledge of breeding in both animals and plants. However, Mendel's motivation on his experimental design has long been debated [66–75]. It has been shown that Napp [60] and Diebl [63] had substantial influence on Mendel, while Nestler's work citing Festetics's [45] paper was also determining in designing his experiments [40,41,76,77]. Research carried out by members of the SBS provided questions for centuries of experimental analysis and was a perfect prelude to Mendel [39,42,78–89]. At this point, the question arises as to why Mendel's 'research network' was forgotten?

Breeders were definitely ahead of their time even with their concept as to how they approached investigating a research question closely resembling modern scientific networks. Their audience failed to understand their explanations due to the questions arising from abundant interchanges of ideas within different fields. This cross-fertilization between different scientific fields is nowadays well recognized for encouraging new developments and innovative thinking [90]. In the spirit of the Polányi-Kuhn perspective, e.g. [91,92], a new paradigm was already proposed in 1819 but the scientific revolution they could have

launched never arrived. At least not in Festetics' lifetime, nor in the lifetime of Mendel, nearly 50 years later. However, why was the research on heredity slowed down between 1821–48? There are several answers to this question, but we should take a closer look on the political climate of this period, which reveal unfavorable conditions.

3. Academic Freedom in Central Europe during the Early 19th Century

Sheep breeders were operating at the time of the Holy Alliance, a coalition between Russia, Austria, and Prussia, aiming to limit liberalism and secularism in Europe after the overwhelming Napoleonic wars. The Austrian state chancellor, Klemens Wenzel Nepomuk Lothar, Prince von Metternich-Winneburg zu Beilstein (hereafter Metternich) (1773–1859), often called the "Coachman of Europe", made his country a bastion against democracy, revolution, and secularism [93] (p. 698). Through the secret police (*Inneres Polizeihofstelle*), Metternich kept an eye on everything and through his contacts, nothing escaped his attention [94] (p. 105). This special unit focused on political and moral (*Sittliche*) crimes committed by foreign or domestic persons engaged in revolutionary, criminal, or immoral activities [95] (p. 39). Beethoven, the famed musician, wrote the following when traveling from Vienna:

> "Several important persons have been imprisoned here. It is said that a revolution was about to break out—but I believe that as long as the Austrians have some dark beer and little sausages they will not revolt. Briefly, the gates to the suburbs must be closed at ten in the evening. The soldiers have loaded muskets. One doesn't dare lift his voice here, otherwise the police find lodging for you". [96] (p. 18)

A huge number of informants were hired to report to the police on the activities and conversations of people in the Austrian public. These reports were delivered to the "Double Emperor" (*Doppelkaiser*), that is, Francis II, nicknamed "the Good", and to Metternich, "the Coachman". It is said that Francis's daily *Morgenplaisir* (morning pleasure) consisted in hours spent reading through these reports, while Metternich enjoyed dropping morsels of information gleaned from secret police findings during conversations with foreign diplomats, to cultivate an aura of omnipotence and omniscience [97] (p. 70).

The empire maintained special control over its education system through the secret police to ensure that "subversive" ideas did not infiltrate students and academics [97] (p. 74). Teachers were fired if they "demonstrated their incapacity to fill their offices" or if they "misused their proper influence on the young, spreading harmful theories inimical to the public order and peace or destructive to existing political institutions" [98] (p. 219–220). The secret police wanted to intercept "dangerous thoughts and nip these in the bud" [99] (p. 67), while another special unit (*Oberste Polizei und Cenzurhofstelle*) maintained censorship over the writings of academics (generally over the entire press) keeping a check on any "Jacobin Conspiracy". After a group of intellectuals formed the ephemeral Hungarian Jacobian movement in private reading clubs (*Lesegesellschaft*) in 1794—in reaction to the restoration of the conservative absolutistic power of Francis II, Metternich, "The Coachman," leader of the secret police, became obsessed that private learned societies and reading clubs were the cradle of antimonarchist and revolutionist movements. In his letters, Metternich became obsessed by the term "Jacobin", which he applied to anyone with any kind of liberal tendencies. The most notable example of such an exaggerated use of the term was when he applied it to Russian Emperor Alexander I [100] (p. 556). Francis II, who ascended to the throne in 1792, abandoned the enlightened, absolutist aspirations of his predecessors, Joseph II and Leopold II, and removed previously nominated state officials. This move turned the reformist sentiments against the new regime, who sharply opposed the restoration of the conservative absolutist system. Under the control of Abbé Ignaz Joseph Martinovics (1755–1795), who was involved in state administration, reformers merged into secret societies under the guise of private learned societies and planned to replace the archaic monarchy with a modern democracy. The "New Hungary" was to become a federation and an egalitarian republic, which attracted discontented nobles and radical

intellectuals consisting of university students, poets, physicians, judges, and clergymen. Before police intervention, around 300 members were enrolled in these societies, which were liquidated in the summer of 1794 and conspirators were executed in Pest. The direct impact of the "Jacobian Conspiracy" was hardly significant. However, the fact that it was supported by intellectuals and governmental officials served as a warning to Francis II and Metternich, who reacted by sharpening the government's trajectory in a more conservative, absolutist direction. In response, he implemented strict measures against the activities of such societies, including the Agricultural Society. Scientific work suffered. In hope of escaping prosecution by the authorities, members published anonymously or used hidden initials in André's journals who served as its editor-in-chief.

Press releases were subsequently verified, and if dangerous texts were found in newspapers and books in the interests of the state, measures were taken to ban them, confiscate manuscripts and prints and, if necessary, to punish or dismiss censors and writers. The censorship invaded the privacy of even high officers of state and members of the imperial family too. Metternich's secretary Gentz complained about this in 1832:

> "You must realize that the mistrust towards on and all, the espionage against one's own confidants and the opening of all letters without exception has here reach heights for which there can scarcely be a parallel in all history". [101] (p. 46)

Hundreds of scholars and academics were fired from teaching positions in the Monarchy for political reasons during the 19th century. Even the titles of books that professors borrowed from libraries were scrutinized by the authorities. Scientific disciplines such as philosophy were barred from the university's curriculum "in view of the scandalous development of this science" [102] (p. 32). Among other things, students were forbidden to study abroad and they were banned from visiting coffeehouses, reading newspapers or form associations. It is therefore a resounding irony that the revolution of 1848, which nearly tore the Austrian Empire apart, started in Hungary by a bunch of students, scholars, philosophers and poets in the Pilvax coffeehouse. The year 1848 ended a millennium of feudalism in Central Europe. The political and economic changes interrupted communication among Moravian breeders and also heavily influenced the work of Mendel [103].

Most Augustinian friars had enrolled in the Agricultural Society and continued their education at the Philosophical Faculty operating in Brno. Mendel, like the other friars, enrolled in classes taught by Professor Nestler, the department's head, and Professor Friedrich (Bedřich) Franz (1783–1860), the physics curriculum's director. Mendel's certificate verifies that he earned excellent grades in the subjects taught by Diebl and Franz [73]. Around 1830, with the permission of Abbot Napp, one of Mendel's fellow members, Aurelius Thaler (1796–1843), a well-known mathematician and botanist, developed an experimental plot in the monastery's garden, where he grew rare exotic plant species. After Thaler's death, another friar, Matthaeus Klácel (1808–1882), took over the small botanical garden. He was a botanist who was also interested in mineralogy and astronomy. Klácel also debated numerous metaphysical topics with another monk, Tomáš Bratránek (1815–1884). Bratránek was a renowned university teacher, Goethe scholar, and author of publications in natural philosophy who ultimately became Rector of the University of Cracow [104]. Mendel entered the group of these two fellow monks, and Klácel became his tutor before he was dismissed from his job as a philosophy instructor. Klácel was labeled a Haegelian after being accused of pantheistic beliefs. Klácel aspired to be a philosophy professor in Prague, but due to political repression, he was forced to work as a monastery librarian until 1868, when he immigrated to the United States. He left the Church and went on to work as a freelance writer for magazines that advocated for progressive social philosophies till, he eventually became an idealistic atheist. He kept up correspondence with Mendel (see [73]). In response a group of monks including Mendel, drafted a petition "in the interest of mankind" requesting citizenship and scientific freedom to dedicate themselves exclusively to research and education without prejudice (see Supplementary Materials Document S1). The petition was originally discovered by Orel and Verbík [103], later examined by

Nivet [105] who concluded based on the handwriting that the petition was written by Mendel.

4. Spreading Liberal Views and Intellectual Enlightenment through Sheep Breeding

The economic growth of the city resulted in cultural development, including an intense scientific life carried out in private learned societies (*Gesellschaften* or *Privatgesellschaften*), which were characterized by a strong economic, industrial, and agricultural interests permeated by *homeland studies* (*Vaterlandskunde*) [106]. This ideology systematically surveyed all aspects of the state, from astrology, geology, and topography to biological diversity, population statistics, history, and folklore of the time. From 1809 on, André published and edited *Hesperus* (meaning: evening star, golden lamp, the planet Venus), the most important journal of Moravia's liberalism, which was intended to convey modern scientific knowledge and new spiritual directions for the Monarchy's intellectuals [107] (p. 52). Members also represented the Josephine Enlightenment, whose thoughts later developed towards concepts of early liberalism. The Josephine Enlightenment, also called Josephinism, refers to policies issued by "the King of Hats" Joseph II, Holy Roman Emperor (1765–1790). During 1780–1790, Joseph II introduced several reforms and attempted to transform the Habsburg Empire into the most Enlightened state in Europe. Joseph II aimed to develop a unitary state building upon an efficient government with fewer feudal institutions and greater degrees of equality and freedom. His reforms were met with serious opposition across the Empire and eventually, on his deathbed, Joseph II was forced to withdraw all but three of his decrees. André's intention to raise the "the art of animal breeding" to the "status of science" was supported by his elder son Rudolf André (1792–1825), who studied animal breeding and helped his father edit the journals published by MAS. The members of the Society recognized the economic benefits offered by wool and accepted renowned foreign experts of sheep breeding as members. Membership quickly grew to 300–400 [108] (p. 288–289).

Imre (Emmerich) Festetics, who had an ongoing correspondence and active contacts with André and Salm, gained admission and regularly attended Society meetings. Having suffered a major injury in 1790 while serving in the military [109], Festetics subsequently focused on study of the natural sciences and animal breeding, making use of the family's enormous library consisting of 80,000 books housed in Keszthely (Hungary) at Lake Balaton. The library contains many scientific works related to heredity, including those of Georges-Louis Leclerc de Buffon (inbreeding), Johann Friedrich Blumenbach (*nisus formativus* or *Bildungstreib* and writings on human races), Johann Gottfried Herder (genetic force), Johann Wolfgang von Goethe (plant archetype), Aristotle (*Generation of Animals*), Immanuel Kant (*Anlage* and writings on races), Christian Friedrich Samuel Hahneman (*Erzeugungskraft* and *Lebenskraft*), Pierre-Louis Moreau de Maupertuis (notes on generation and polydactyly), René-Antoine Ferchault de Réamur (notes on the freshwater hydra), Charles Bonnet (heredity and preformed *homunculus*), Claude Perrault (notes on regeneration), among many others. There is also a large collection of books about animal breeding, for example, works of the German agronomist Albrech Daniel Thaer and George Culley's book on inbreeding [110]. He began experimenting with animal breeding with a strong emphasis on sheep on his estates in Paty (now Kőszegpaty) from 1803 to 1847. Both Imre and his brother, György Festetics (1755–1819) were strong supporters of André's activities in Brno. György became renowned as the founder of the first continental college of agriculture, Georgikon, in Keszthely. The college is still operational today as an independent campus of the Hungarian University of Agriculture and Life Sciences (MATE) in Hungary. The Georgikon model farm conducted experiments, in part with André's supervision and evaluation. André viewed the Georgikon as a pioneer in agricultural sciences that, as an institute of a higher education, elevated the value of private learned societies. The close relationship between the society and the institute is shown in that André himself was briefly an assessor at the Georgikon. Teacher exchange programs and organized study visits promoted the education of plant and animal breeding and were typical between the

Agricultural Society and Georgikon (see [106] (p. 42)), [111] (p. 462). The Moravian Agricultural Society set on the path to become recognized in Europe as a center of excellence in agricultural sciences whose reputation was enhanced by its international connections.

The success of the Moravian textile industry was spurred by the introduction of noble Merino sheep from Spain, which for centuries had been strictly regulated. However, the attempts to introduce these sheep, prized for their "highly esteemed wool, with exceptional fitness, softness and silkiness," to other European countries failed since the breed quickly degenerated [112]. It was believed that despite great efforts to provide the best feed and housing, the effect of "natural climatic degeneration" (*die natürliche klimatische Rückbildung*) disrupted "the main plasma of the animal organization (*Hauptplasma der thierischen Organisation*) [29] (p. 92–93). Breeders believed that powerful external environmental forces such as altitude, soil, and foodstuffs played decisive roles in the modification of their livestock [113] (p. 3). Stemming from long-held views, degeneration was associated with hereditary diseases, with divine laws equally valid for animals and humans, both the result of benevolent creation.

The introduction of a mechanistic view allowed eighteenth-century breeders to think of how to better exploit the potential of their livestock. If animals were machines, their bodies could be repaired from the damage caused by external forces or even degeneration. Breeding often resulted in unforeseen changes, thus farmers became aware of the capacity of animals to change under human control. For some breeders, the effect of the seed (a concept that dated back to Hippocrates) was as equally dominant as climate.

Thus, the challenge facing Moravian breeders to improve sheep wool raised the following questions:

1. How can animal body plans be modified? Do climate or seed (i.e., what we know call ''genetics'') affect the formation of matter?
2. Can new forms be created through breeding? In other words, can human intervention interfere with God's creation modifying a stable entity?
3. Do results from animal breeding apply to humans as well? Are humans subjected to the same hereditary degeneration observed in sheep giving rise to monstrosities?

These questions, arising during the Napoleonic Wars, were neither solely philosophical nor theological; they had important economic implications. Thus, breeding became a pivotal issue influencing the outcome of the war. For the members of the Agricultural Society, the mystery of generation (*Zeugung*) was an enthralling scientific question and a new arena of experimental research to investigate. In the early nineteenth century, sheep wool united politics, economics, and science through war. Climate and seed increasingly became essential elements of the discussions of animal breeding in Brno. Members began to scrutinize whether climate or seed had unfavorable influences on continuity between generations. Some believed that the original form of Merinos is maintained due to climatic conditions. Others believed degeneration (*Ausartung*) was related to seed.

Based on trial and error, members increasingly began to believe that controlled upbringing of animals and selection during breeding complemented each other when applied effectively. The transmission of the seed of an animal might be responsible for stabilizing the breed and for giving rise to new forms. According to Martin Köller's "law and process of nature" (*das Gesetz und Gang der Natur*), "noble sheep (*edles Schafvieh*) without hereditary defects (*Erbfehler*) crossed with ewes without hereditary defects produce offspring also without such defects" [114] (p. 295). This observation linked the transmission of traits from one generation to another without external influences, proving that the essence of a "noble race" (*Racethiere*) is found in the inner structure of the animals. As a result, the question of generation, which determined scientific thinking on the study of development in the 17th and 18th centuries, became a central issue for animal breeders. During the eighteenth century, the concepts of heredity and development were not distinguished clearly as describing distinct phenomena. For the scientists of this age, heredity constituted only a step within the infinite process of development; it did not occur to them that transmission processes can and should be studied separately. Therefore, they propounded dozens of

theories about the mysterious process called "generation". Most of them were based on the presumption that a preformed embryo existed in the sperm (seed) or in the ovum (egg). Many scholars considered sperm (seed) as the carrier of hereditary material, while the ovum was akin to the soil on, which a seed is planted. The German natural philosopher Blumenbach described epigenetic development to the action of the *Bildungstreib* inherent in living organisms. His work was reviewed in 1797 by C.C. André, who confronted *Bildungstreib* with observed facts noted in animal and plant breeding [115].

André edited a third journal entitled Patriotic Daily News (*Patriotisches Tageblatt*, PTB) from 1800 he reported about the use of breeding methods in England [116]. Although André did not sign the article by name, presumably he wrote it. In 1804, he published the German translation of Culley's book "*Observations on Livestock*", which made André publish an animal breeding article—mostly discussing inbreeding methods of Bakewell—in 1809 with a footnote [117]. According to André:

> "The English have made the greatest progress, especially in animal husbandry, and through long-term observation and persistent attempts to discover the most correct, safest methods based on the laws of animal reproduction (*die Gesetze der thierischen Fortpflanzung*). [. . .] The application and usefulness of ennoblement (*Veredlung*) is based on the following experiences . . . that can be achieved in three ways: I) inbreeding (in-and-in breeding) pairing individuals of the same race based on valuable characteristics; II) crossing or mixing different races; and III) avoiding further interference and ennobling only through inbreeding. This method is the fastest and most effective way of improvement. However, the prejudice against mating in close relatives must be banished with this refinement". [117]

According to this footnote, the original article was to be published in the volumes of PTB in 1805, but the publication was interrupted by the sharp reactions of the censors to the idea of inbreeding. With consanguineous matching, there was a chance to fix by "blood" specific traits of animals. Although Bakewell earned great fame, his inbreeding methods were opposed on religious grounds. Proponents of "Divine Law" rejected the consanguineous matching of sheep, which went against the cultural norm of the incest taboo. Gottlieb Carl Svarez (1746–1798), the Prussian jurist and reformer, drew examples from animal breeding in his lectures (1791–1792) to justify the moral objections against incest:

> "The reasons for which marriages among close relatives are prohibited are partly physical, partly moral. The physical reasons are based on experience, which one has made with all kinds of animals that from the mixing of too closely related blood, races develop which—in particular when the mixing is continued through several generations—are marked very unfavorably by weakness stupidity, depravity". [118] (p. 317)

In the early 19th century, only Ferdinand Geisslern (1751–1824), called the "Moravian Bakewell," and Imre Festetics, the "Hungarian Geisslern," were applying inbreeding to improve wool quality in Habsburg lands. At that time, the atmosphere was politically overheated due to the Napoleonic wars. However, this discussion was not simply about sheep. As Gianna Pomata [119] (p. 145–152) has shown, the discussion of inheritance stemming from recurrent health problems was also a critique of the aristocratic family model. The hereditary aristocracy rested on the idea of the transmission of "noble essence," which required a purity of bloodlines untainted by interclass marriage [120] (p. 143). In early 19th century France, physicians abandoned old Galenic traditions and advised noble families –part of the practice called *hérédité*—on how to retain the essence of nobility in their marriages to avoid diseases and defects [121]. Even the lower classes were aware of the "noble diseases" of aristocratic and royal families. The rapidly growing classes of the landless poor, who believed themselves to be the subjects of this hereditary system, mocked the "noble features" and "degeneration" of the aristocracy [122] (p. 155–174). The upper

class viewed the lower classes as threats to the social order [119] (p. 151). Thus, Francis II intended to maintain the traditional social fabric of the empire and enforce aristocratic, class-based structures of inheritance resting on "Christian values."

The publication of PTB was suspended in 1805 and André published his paper in *Hesperus* [123]. André reacted to the suspension of PTB by planning to leave the Habsburg Empire and to resign as secretary of MAS. As he told his friend Julius Franz Borgias Schneller (1777–1833):

> "My Viennese observers, some of whom are very lazy make sure [. . .] I should be afraid that some things will never get into your hands, due to endless espionage. I was forced to leave since they withheld the food for my mind . . . and the Patriotic Daily News had to be stopped. I had no army to command and had no plans to violate the law so I decided to leave, but the Emperor himself kept me back and Count Lažanský, the regional chancellor, requested me in a very flattering official letter to resume my pen again. I made two conditions: first, for a more liberal censorship of my writings, which has rarely been fair to me; and secondly, for the free admission of all books sent to me from abroad as materials". [124] (p. 335)

5. Sheep Breeders in the Dragnet of the Secret Police

André's local survival had a decisive impact. He took the organization of private learned societies to the next level and reorganized their activities under a private research institute to study several branches of natural sciences, including, astrology, mineralogy, meteorology, practical agriculture, pomology, animal and plant breeding intellectual life had been blooming in Brno, attracting scholars of various disciplines permeated by the spirit of "homeland studies" (*Vaterlandskunde*). The physicist Franz Ignatz Cassian Hallaschka (František Ignác Kassián Halaška) (1780–1847), for example, established an observatory in Brno and published his observations on sunspots in André's *Hesperus* [125–128]. André's editorial concept in *Hesperus* evoked the ideal of English social and economic organization, as well as the idea of a Czech–German–Hungarian scientific cooperation that was related to the idea of the historian Josef Hormayr (1781–1848), who was imprisoned in Spielberg [129]. This prison, or 'royal seat of the lords of Moravia' in Brno, was a designated place of exile for political prisoners, which was immortalized by the Italian dramatic poet Silvio Pellico (1789–1854) in his book My Prisons (*Le mie prigioni*). After his release in 1816, Hormayr lived as a long-term guest in Count Salm's castle in Rájec-Jestřebí [130]. Moravian aristocrats were strong in their support of the intellectual movement. They openly declared themselves the proponents of freedom of the press, which had fallen under strict censorship. Nobles and sheep breeders promoting economic, cultural, and intellectual development began exchanging their ideas through personal letters across the empire.

Moreover, members of society travelled throughout the empire to debate on various intellectual subjects; for example, Count Salm and Count Imre Festetics exchanged ideas about national movements, linguistics, and poetry [106] (p. 52); [131]. Furthermore, Festetics established a sheep breeding society in Hungary that mirrored the organization of the SBS in Brno, to spread the scientific and intellectual views forged in the "Austrian Manchester". The members of these "clone" associations travelled to each other's meetings, where they were also elected as official members. The existence of these societies was viewed, however, as a threat. The secret police thought that such activities could pave the way for the recurrence of revolutionary activates. Powerful movements were at work embodied in a series of natural philosophies that inspired political ideologies. These then melted into and merged with liberalism, which was being promoted in scientific societies like the SBS, but which was also closely watched by the secret police and their informants.

Sheep breeders continued to refine their ideas on breeding principles, and they worked hard to build a solid institutional background for scientific animal as well as plant breeding. Meanwhile, the long, drawn-out war against Napoleon came to an end. The agricultural boom during the war, which had encouraged landowners to borrow money and to buy new estates or to establish wool mills also ended. Most of them went bankrupt after peace

was restored in 1814 [132] (p. 159). The first years of the century, marked by the Napoleonic wars, not only brought frequent changes to the economy and to governmental *policies*, but also marked the end of educational and scientific institutions. The "Sheepy Bunch" (*Juhos Társaság*) in Brno had to learn how to operate under the newly formed Holy Alliance (1815–1853).

André was hiding under the guise of Austrian patriotism to survive in the relatively unfavorable conditions of late feudal absolutism. The secretly enlightened governor, Count Lažanský, protected André from the censorship of his extensive correspondence with foreign collaborators until his resignation. André and other SBS members, like Salm and Festetics, felt the increasing pressure of censorship by state authorities, when the secret police started to open their private letters. This was done in special mail-opening departments (*Logen*) attached to every major post office [133], where informants copied the content of personal letters. Police reports on the activities of SBS members were signed by Count Josef Sedlnitzky (1778–1855). Moreover, Sedlnitzky used an extensive network of secret agents for surveillance to supplement his reports [134]. In these accounts, André was described as 'good for nothing and as a ready liar', while 'the same description could also be used for his son Rudolf' [135].

According to Sedlintzky, André was driven by an insatiable ambition to become a demagogue and a distributor of liberal revolutionary ideas, which was coupled with a morbid vanity [31] (p. 623). His plans to build a research institute to study several branches of natural sciences, including practical agriculture and heredity, was closely followed by the secret police. André and Salm were gathering funds among aristocrats from the Auersperg and Mitrovský families to support the establishment of the institute. Seeking advice, they actively corresponded with Count Ferenc Széchényi (1754–1820), who founded the National Library and the National Museum of Hungary in Buda/Pest [130]. André's activities were suspicious in the eyes of 'The authorities' who were doubtful about the views that would be spread in the newly opened institute. To mitigate any concern, André and Salm named the new institute after the emperor, Franzes-Museum (now the Moravian Museum) in Brno established in July 1817.

Further suspicion arose after the debates about inbreeding in May of 1817 championed by Festetics, leading to his publication "*About Inbreeding*" [45]. A sign of the new and lively interest in biological inheritance in Brno was echoed in the pages of ONV, which appeared in volumes vol. 19 and 20 and supplements in 1820. Festetics's inbreeding methods were conceived as innovative and as challenging old incest taboos. The acceptance of these breeding methods required the separation of religious and biological questions—a step, which many were not yet willing to take (see [136]). Incestuous relationships were prohibited; thus, sheep created through this inbreeding process were regarded as monstrous creations of nature. Sheep were also viewed as religious Christian symbols, which were now dancing with the morals created in complete freedom from the bonds of matter through inbreeding. Society was unwilling to accept the artificial modification of nature.

The Franzes-Museum opened on 5 May 1820 and Festetics offered his best inbred rams to the new institute to challenge pre-existing frameworks with a greater potential to trigger the formulation of further evidence in the study of heredity [137]. André surrendered as a successful organizer of scientific progress in Brno on 20 May 1820 by resigning as the leader of the SBS [138]. Many members followed André, while Count Salm formulated a petition in which he praised André's merits and asked the members of the SBS to support it. Festetics wrote in favor of André that 'he has been inspired to visit the Olympus of Agriculture, which widened his knowledge, and he became more enlightened' [137]. Nevertheless, no praise or action on behalf of this committed teacher, writer, economic adviser, organizer, however justified, was sufficient to prevent the axe from finally falling [77].

6. Inbreeding Based Heredity Research Nipped in the Bud

According to the police reports, André was forced to leave Brno in September of 1821 and he became persona non grata in the Monarchy for his views. He moved to the cloth-manufacturing city of Stuttgart and became the adviser to the Prussian King, Wilhelm I. His departure was, at a minimum, a symbol of the restrictions that inhibited intellectual life in Brno [34]. To quote Emperor Francis II himself from 1821:

> "I have no use for scholars, but only for good citizens. It is up to you to mold our youth in this sense. Whoever serves me must teach what I command; those who cannot do this or who engender new ideas can leave, or I shall get rid of him". [139]

With André's exile, Moravia lost the pioneer of the industrial and agricultural revolution. Therefore, the further development of natural science and further discussions about heredity and inbreeding was slowed down. Later on, Festetics [131] wrote to Salm that his heart was broken and that he 'feels that everything that they have been working on for the last two decades is now lost'.

André's physical separation and the 'criminalization' of his work created a credibility gap among the members of the society in terms of continuing the investigations of heredity and inbreeding. Sheep breeders, scientists, and society itself was divided. One camp—previously led by André, Festetics and Salm—was supporting inbreeding to create 'noble' lines of sheep to 'concentrate' valuable characteristics. On the other hand, there were those who feared the unpredictability and the danger of disastrous consequences arising from such inbreeding, particularly in terms of fertility. This controversy was heightened by religious considerations about incestuous mating, thereby transgressing God-given law [77].

Without André, it was impossible to shift the balance in support of inbreeding. André tried to continue his work in Brno through his son Rudolf, but the work of the secret police did not allow this, as the harassment of those supporting inbreeding continued. The letters sent to André by the sheep breeders were first sent to Salm in Rájec-Jestřebí, according to Festetics [131]. Salm then sent these letters to Stuttgart by way of the publisher Johann Friedrich Cotta to escape the attention of the secret police. The ploy did not work. Letters were intercepted and communication with André became almost impossible. André lost his son possibly to pneumonia in 1825, isolating him even more from Brno. He asked help from the members of SBS and volunteers to continue his editorial work and influence on scientific development [140]. A few years later (1831) André passed away, soon followed by Hugo Salm (1836). Perhaps in fear of the secret police and of losing his land in consequence, Festetics no longer spoke of inbreeding, at least according to our current knowledge. His brother György (Georg) Festetics (1755–1819), the founder of the first agricultural college in Europe, Georgikon where André was an assessor in 1821 was already under the surveillance by the secret police. György, as a Graeven Hussar regiment officer, was one of the signatories to the application of the order of Bratislava (Pozsony) and become disgraced in the monarchy [141]. After the events, he retired to his estates in Keszthely at lake Balaton where the family housed an enormous library of 80,000 volumes of books constantly used by Imre Festetics. In 1797, at the Zala County General Assembly, György voted against the insurrection of the French Revolution. As a result, György Festetics lost his chamber key and Francis II forbade his appearance at the court [141]. György then withdrew from any open political action but did not disclose the aims of education. The secret police were constantly inspecting him, which made his collaboration with Imre difficult. According to Albrecht Thaer in 1823, the Sheep Breeders' Society was dead [138]. In Stuttgart, André continued to publish the journal *Hesperus* where he openly spoke about the censorship against him and against the Moravian Agricultural Society, for example in his paper "*Price of Hundred Ducats*" (Supplementary Materials Document S2) [142].

7. Conclusions

Debates about sheep breeding with scholarly deliberations on the question of heredity were deeply intertwined with philosophical and political questions in the early 19th century. While breeders already put their knowledge into practice on the transformation of races,

from one to another, theoreticians, society, and the state power were more skeptical about the significance and permanence of such changes. Proponents of "Natural Law" rejected the incest taboo as a cultural norm; they were, however, bound to frameworks that were more traditional. Deviations from the "original form" of animals were understood as degenerations, and such monstrous creatures were not allowed to have a lasting influence on nature's overall design [136]. It is more than remarkable that the peculiar interest in heredity reached its peak at a time when the political repercussions of "the genetic laws of nature"—with its claim of natural equality—were strongest.

This new attention to hereditary could only emerge against the backdrop of the promise of natural equality. Once this promise had been stated, it required immediate political intervention from the state power to nip such liberal views in the bud. This political background in Brno may finally explain, at least in part, the attitude (neglect) of Mendel towards the sheep breeders and even more, the half-century long neglect of Mendel's own discoveries [143].

This case from 19th-century Brno offers a stark warning against political interference with science. Indeed, the fate of pre-Mendelian heredity research in the Habsburg Empire is a clear-cut example of direct suppression. This kind of unfortunate political interference with science is something that we still need to be on the lookout for today.

Supplementary Materials: The following are available online at https://www.mdpi.com/article/10.3390/philosophies6020041/s1, Document S1: Petition of six Augustinian friars, Document S2: The price of hundred ducats by C.C. André.

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