BIOLOGY BETWEEN UNIVERSITY AND PROLETARIAT: 
THE MAKING OF A RED PROFESSOR

Nick Hopwood
Cambridge Welcome Unit for the History of Science

German professors in the early twentieth century were notoriously conservative, but extraordinarily among those who held forth in the lecture halls of the Weimar Republic, Julius Schaxel (1887–1943) aspired to be “a soldier of the revolution”. 1 Student of the Darwinist prophet Ernst Haeckel, experimental embryologist and professor at the University of Jena, at the end of the First World War Schaxel decried a deep crisis in the biological sciences and projected theoretical biology to resolve it. But by 1924 he had been branded a “red” professor for his involvement in socialist university reform. Bringing the theoretical programme together with Marxist politics, he now argued that the crisis in biology was a reflection of the crisis of capitalism. He reckoned that since the “bourgeois” universities would not reform themselves, only the organized working class could achieve a resolution. But he insisted that science would be saved only if Marxist biologists took the lead in producing a “socialist science”. One of the Weimar scientists most hated by the Nazis, in 1933 he was forced into exile in the Soviet Union, where he died during the Second World War.

Schaxel’s politics made his reputation strikingly different in the two post-war Germanies. In the Federal Republic, as in the other capitalist democracies of the Cold War, Marxism officially failed — and this orthodox Marxist had little to offer the New Left. Struck off membership lists under National Socialism, he barely figured as at all in the disciplinary memory of biology. In the German Democratic Republic (GDR), by contrast, the forces of his adopted country ensured that he would be honoured in Jena for several decades after his death. Scholars were required to celebrate this “true Marxist among the biologists, first biologist among the Marxists”. 2 Schaxel’s politics had to be handled carefully even here. That he had begun his political career not as a communist but as a social democrat could be explained quite easily, but rumours that Soviet exile had been a bitter disappointment that finished with his murder were passed over in tell-tale silence; that he seemed nevertheless to have ended his life a doctrinaire Stalinist made him unconvincing to those who worked to overturn Lysenkoism. But it was above all the success in the GDR of a version of Schaxel’s project that tended to discourage critical reflection on his scientific politics. Now that after-life is over, German reunification risks merely discrediting him. 3

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Schaezel’s politics is only the first of three ways in which his legacy is fraught. A second is disciplinary: theoretical biology, the field he played a key role in organizing, did not achieve the successes its interwar practitioners expected. Embryology, their main concern, was dominated instead by Hans Spemann’s school, whose participants included Viktor Hamburger reckoned Schaezel “a minor figure”, who “had no influence on our thinking”. Though marginal to this winner’s history, as a theoretical biologist in the 1920s Schaezel was actually a major figure. He was also the last Weimar Republic’s most prolific and prominent writer on Marxism and natural science. But this very political engagement for which he was celebrated in the GDR appeared to coincide with his retreat from the scientific coal-face. By 1924, he had all but ceased to produce new work for specialists; he concentrated on popularizing biology in the labour movement. This provides a third, and perhaps the fundamental, reason why Schaezel has been marginalized: he mounted his political critique of biology primarily, not in academic fora, but for organized workers and socialist educators. As a result he has — with, we shall see, perhaps poetic justice — fallen foul of the problematic status of popular science, ‘popularization’ and of stabling them.

This paper contributes to the histories of science and socialism, of biology — specifically embryology, theoretical biology and Darwinism — and of science. ‘popularization’. But my main aim is to show how in Schaezel’s practice as a scientist in the Weimar Republic these histories became intertwined. Dieter Fricke outlined Schaezel’s “life” and political ‘struggle’. Paul Weisflog drew attention to this distinctive figure in the biological politics of the Weimar professoriate, and Herbert Mehtens highlighted the conspicuous critic of biology under National Socialism. Georg Uschmann quoted Schaezel in the institutional tradition of zoology in the University of Jena. Reinhard Mocck assessed him in relation to other experimental embryologists, and Jonathan Harwood used Schaezel’s theoretical analysis as an index of the widely felt crisis in the life-sciences after the First World War. Helmut Vetter focused on Schaezel’s work for the socialist popular-science magazine Urania.1 Here I bring these partial perspectives together by showing how the experimental and theoretical biologist became a Marxist who produced biology for organized workers as the principal means of his struggle over science. I stress the contingency of Schaezel’s choices and emphasize the way he moved between different arenas. The Schaezel historiography of the GDR was dominated by censored extracts from his unpublished autobiography, but it continually risked being undermined both by its significant silences and by the mere or less privately voiced opinion that as a scientist he had ultimately failed. I attempt to make a space for reflection by refusing the reductive choice between hero and failure, and this involves suspending also of Schaezel’s own heroic narrative and its implicit claim that he had always already known what he was going to do next.2 Presenting an account of a making, I show instead how he constructed a career and its meaning from the available resources as he went along, how he recast a non-Marxist project of biological reform into a programme for “socialist science”. Exploring in the process the relation and
distinctions between the arenas in which he produced biology for different audiences. I suggest how this career might challenge received accounts of Weimar science.

As the particular constellation of disciplines, institutions and practitioners with which we are still most or least familiar today, natural science had largely been made by the end of the nineteenth century. But by focusing on the changing relations between scientific institutions and other arenas in which natural knowledge was produced and challenged, we can explore ways in which the status of sciences, scientific institutions and scientists remained and remain contested. It is useful to note first that though the twentieth century began with the German universities still the most prestigious sites of research and teaching, we should be wary of following historians of biology Emanuel Rädi's 1909 dictum that "German science" means the universities. By the time he was writing, the growing university system was increasingly being supplemented by other institutions: the technical colleges had gained the right to award doctorates; more chemists worked in industrial laboratories than in academia; the Kaiser Wilhelm Institutes would soon join other mixed public and private centres of scientific, military and commercial innovation; and scientists increasingly worked in government agencies, medicine, agriculture, forestry, zoos and marine stations. Historians of Weimar science are showing how the science produced in these institutions was constituted by scientists' participation in wider cultures. We also know a good deal about how the sciences were used to transform German society. But we do not do justice to struggles over science simply by investigating how specialist science was culturally embedded, and then adding "the popularization of science" or the multiplication of scientific cultures to a narrative in which the privileged status of the official institutions — however inclusively defined — is taken for granted. To investigate the political geography of the sciences we need to study non-specialist arenas not in isolation but in their relations to the official institutions, and reciprocally: to analyse how those institutions sought to defend or enhance their status. People in the "scientific" 'twenties continued to a surprising degree to contest more than theories, technologies or even world views. At stake still, and especially in these crisis years when the threat of war and political upheaval were ever present, was who would produce knowledge of nature, for whom, where and why. Much scholarship has been concerned with the universities and National Socialism. Here we explore the relations between academic biology and the culture of the organized working class, and see biology university science into the major political confrontation of the Weimar Republic.

Socialism is present in histories of German science in the late nineteenth and early twentieth centuries, but it is easily marginalized by the ways in which it has appeared. First, the state's monopoly of the universities ensured that very few scientists were socialists — and historians of science increasingly treat their subjects' politics as rather trivial anyway. Bruno Latour has argued persuasively that what is most important politically about the work of scientists is not their political commitments or their ventures into politics narrowly understood, but what they do in and
using their laboratories. Second, socialism has been kept at arm's length. Certainly, it has often been argued that scientists' work, and Imperial science policy more generally, attempted in the face of the largest socialist party in the world to incorporate the working class into the nation. But in the history of science as the history of anti-socialism, the left remains a distant threat. Socialism is confined to arenas to which Darwin can safely "descend," or to 'applied' science. Third, and most important, socialists in the decades around 1900 are often considered to have had such faith in science that they posed no real threat. For, from the nature philosophy of the influential later writings of Engels through the expositions of the "pope of Marxism" Karl Kautsky to the socialist leader August Bebel's popular introduction, Woman and Socialism, Marxism was modeled on and imbibrated with, the natural sciences. The standard forms of these arguments have effectively marginalized socialism from the history of science because there is truth in all of them. Laboratories have made much more difference than those left scientists who have occasionally strayed across the stage of world history: the astronomer Anton Pannekoek, the major theorist of left-communism, or the geocentric physicist Friedrich Adler, who assassinated the war-mongering Austrian prime minister Count Stürgkh. Socialists were kept as far from power as possible. And Marxists generally did not reject natural science. But if few socialists fought science, many struggled with it and over it: they claimed that where science was not biased by the class interest of the bourgeoisie, it justified and underpinned socialism; and they boasted that in the socialist future the labour movement, as the legitimate her of German culture, would take over and improve the sciences out of all recognition. If not as radical as many have since wished, this was a major challenge to official science. Here I show that by taking Schæzel's practice as a socialist scientist seriously, and especially by following him in his work with socialists outside the universities, we can see how he eventually confronted his academic colleagues with the threat of science as a socialist form of knowledge. I argue, then, that he was not irrelevant to academic biography by 1924, but was rather becoming involved in a much more general and far-reaching challenge.

It is important, however, to appreciate that Schæzel's work for a "socialist science", though in some respects a radicalizing initiative, aimed also to limit and harness an existing threat. Schoolteachers, writers and journalists were much more important commentators of science to socialist audiences than scientists, who were less inclined to political activity than their colleagues in the humanities, and conspicuous by their absence from the labour movement. But Marxist scientists are especially interesting because they were also involved in esoteric science. This gave them unique resources, but meant that they had to negotiate the acute problem that to be a scientist and a socialist was to participate in "thought collectives" that were generally hostile. Isolated among the faculty, neither could Schæzel be sure of a warm welcome in the labour club. The rights and duties of all intellectuals in the unusually proletarian German Social Democratic Party had been a matter of strident debate even before Bebel's famous comment at the 1903 party conference.
"Look at every party member, but if it is an academic or an intellectual, then look at him twice and three times." 57 And as a scientist between the World Wars, Schassel faced special problems. Socialist interest in science was declining from the great age of natural-scientific enlightenment before 1914, some socialists joined members of the educated middle class in blaming the natural sciences not just for the disenchantment of the world but for the horror and destruction of the War, and by the end of the 1920s many workers held science responsible for rationalizing them out of a job. Gary Wenzky’s fine collective biography tends to present J. B. S. Haldane, D. J. Bernal and other British left scientists of the 1930s as effortless entrepreneurs of science, whose huge charisma was enough to get things done. 58 But though Haldane and Bernal were more firmly established — indeed Establishment — before they began to link science and left politics than Schassel, Bernal had to acknowledge "the deep distrust of the working class for science as it is practised today." 59 Being a biologist among Marxists could be nearly as problematic as being a Marxist among biologists. Schassel had to work as hard, if with better prospects of success, to persuade other socialists that socialism needed his science as to convince other scientists that science needed his socialism. Producing biology for these two contrasting audiences produced also the constrained radicalism of this socialist expert, who when he wrote in Urania was actually working to restore the authority of (a reformist science and of (socialist) scientists.

First I place Schassel in academic zoology during and immediately after the First World War. Having sketched his earlier embryological studies, I focus on the genesis, purpose and reception of his theoretical work. He argued that the biological sciences were in deep crisis, but that this could be resolved by an ambitious programme of "theoretical" and "general" biology, and in particular by regulating the highly contested distinctions and relations between specialists and popular science. As the country was convulsed by the Revolution that followed Germany’s defeat, Schassel also joined the German Social Democratic Party (SPD) and became much more heavily involved in university reform. But this does not mark the major discontinuity in his biological writing. Although his work as a reforming biologist, which I discuss in the first section, and his practice as a socialist reformer, which I describe in the next one, should certainly be understood as aspects of the same project, the major change did not come until 1924. That was when the left’s more general educational reforms were blocked and his reactionary university ostracized him for his involvement in these. Publicly bringing Marxism and biology together, he now transformed general biology into "socialist science." He drew on his analysis of the crisis, and concern with the proper relations between biologists and their publics, to claim that the decisive cultural struggles were taking place outside the "bourgeois" institutions of higher learning: only the organized working class, he announced, could reform them and their "bourgeois science." However, as I discuss in the third section, Schassel insisted that only the socialist scientist could provide the knowledge workers needed in order to recognize their position in nature and society, and so change it. This was the crucial political function that he gave his
writing for the socialist press. He could not altogether set the terms of socialist cultivation of science, but he did succeed in establishing a position from which to put radical scientific reform more firmly on the left’s agenda. By carefully managing his relationship to the warring social democrats and communists, he was able, as I show in the fourth section, to bring his brand of socialist Darwinism into the culture of the labour movement. Finally, in the last section, I reflect on the significance to his various audiences of the “dialectical biology” that Schael articulated in the last years of the Republic. This he invoked in his contributions to the socialist freethinkers’ festivals of the summer solstices, but what did it mean when he claimed that here was the biology of the future, which he would bring home to roost when the proletariat stormed the universities?

1. THE CRISIS OF THE LIFE SCIENCES AND THEORETICAL BIOLOGY

Schael was the last pupil of the evangelist of German Darwinism, the zoologist Ernst Haeckel, and made his career in Haeckel’s University of Jena (Figure 1). Haeckel was a highly controversial figure both within academic zoology and in popular culture, but he was best known for riding roughshod over such distinctions. As he neared retirement, the evolutionary morphology that he had articulated in the 1860s had become less a programme of research than the butt of polemics, but the
aged visionary spent most of his time arguing for an enhanced role for science in public life and preaching a "monistic" natur-religion that supposedly overcame the "dualism" of Christianity. Reading these works of monism had, for Schazel as for so many others, given direction to teenage revolt from a bourgeois milieu (his father was a businessman in Augsburg), and brought him to Jena to study with the prophet in 1906. Here he forged a career from the intense clash between the sweep of Haeckel's zoological philosophy and the values and standards of the zoological community, especially those of the new experimental biologists.25

Though he was exceptionally close to Haeckel, Schazel's 1909 doctorate was awarded for cytological analyses of oogenesis carried out in Richard Hertwig's Munich laboratory under the supervision of the geneticist Richard Goldschmidt. He went on to undertake an increasingly experimental analysis of embryonic cleavage in marine invertebrates, and soon became involved in Entwicklungsmechanism ("developmental mechanics"). His champion, anatomist Wilhelm Roux, had critized Haeckel's evolutionary morphology for subordinating individual development, which Haeckel had called "ontogeny", to evolutionary development, which Haeckel had named "phylogeny". Instead of explaining how an embryo developed from one stage to the next solely in terms of a series of ancestors, Roux argued that scientists should use experiment to ask questions about the proximate causes of embryogenesis. He was widely, if perhaps too simply, presented as having used his own experiments principally to support the speculative "determination machine" of the zoologist August Weismann, in which cells were progressively determined by the self-disassembly of an inherited complex. Haeckel rejected Roux out of hand as a mechanism who failed to appreciate phylogenetic causation, but Haeckel's younger student Hans Driesch actually went much further than Roux in announcing that an historical science was a contradiction in terms. He attempted a mathematical-mechanical explanation of ontogeny, but by the early 1900s espoused a vitalism in which the development of the embryo was directed by a non-spatial and immaterial "entelechy".26

Much turn-of-the-century research on embryos had little to do with these heroes of experimental embryology, and many experimentalists found that they could work independently of high theory. But when Schazel came on the embryological scene, it did appear to him that the field was divided by the two rivalled oppositions between mechanism and history, and between mechanism and vitalism. And a late student of Haeckel whom others had directed to "modern" biology reckoned he could do no better than engage with the modern and experimental affront to monist free thought that was Driesch's vitalism. Schazel's 1915 book, Die Leistungen der Zellen bei der Entwicklung der Metazoen (The activities of cells in metazoan development), summarized his results and used them to discuss the progressive determination of cells in development. Quite traditionally, he rejected both the "determination machine" and vitalism. But unusually, he did not just reject Driesch's vitalism, he even insisted that there was nothing remarkable about its main experimental support, Driesch's celebrated discovery of the early 1890s that a whole sea-urchin
embryo could develop from a part. According to Schaxel, who had repeated and
reinterpreted the experiments, a whole larva formed if, and only if, the part had the
same constitution as the whole embryo from which it was isolated. Deeming the
existence of what Driesch had christened "harmonious-equipotential systems",
he argued that it was highly misleading to suppose that "atypical" structures created
by experimental intervention could "regulate" towards the formation of an harmo-
nious whole. His own solution to the mechanism-vitalism controversy leaned heav-
ily on Roux. In Schaxel's minimalistic theory of development "in successive acts",
each stage was simply determined by the resultant of the individual cellular activi-
ties of the previous one.
Schaxel's attack gave Driesch a welcome opportunity to defend himself, and
the two men polemicized in the pages of the *Biologisches Centralblatt.*2' Driesch at-
tempts to save the "harmonious-equipotential system" by distinguishing it from his
own vitalist conclusions. In his support he cited the outstanding embryological experimenter Hans Spremann, director of a division at the Kaiser Wilhelm Institute
of Biology and the most successful zoologist of his generation, who had made a
similar distinction when he commented on Schaxel's lecture at the 1914 meeting of
the German Zoological Society. He asserted that Schaxel had "confused" the con-
cept of the "harmonious-equipotential system" with the conclusions Driesch drew
from it. He claimed that it was possible to "reject the latter and still perceive in
the former a fundamental problem of developmental physiology."25 But Schaxel repu-
diated this remark, arguing that "confusion" was anathema fostered by retaining the
theory-laden concept without accepting Driesch's conclusions. Crucially though,
the field was sufficiently loosely structured that none of the three men had to modify
his views as a result of their exchanges.27
This polemic appeared in wartime, as professors looked to the 'defence' of Ger-
man Wissenschaft. Neither Driesch nor Schaxel took part in the intellectual mobili-
ation, but Schaxel, sustaining an illusion of purity that he would later work to
dispel, lamented that "external circumstances" were so "unfavourable" to their pur-
suit of "pure science".28 Actually, his stock rose steadily during the war, and he
profited from being a representative of experimental zoology and member of
Heckel's circle at a university that was somewhat in decline had access to the
significant private funds of the Carl Zeiss Foundation. This had been set up by the
scientific entrepreneur Ernst Abbe to dispense the profits accumulated by what were
coming the town's main industries, the Carl Zeiss opti-cal and precision engineer-
ing firm and the Schott glassworks.29 Die Leistungen secured Schaxel an außerordentliche professorship of zoology in 1916. Two years later Heckel's protégé
and Ordinarius of zoology at Breslau, Willy Kükenthal, told his raconteur that he
would put Schaxel, "one of our most promising younger colleagues", on the list of
candidates to succeed him should he, as he did, move to direct the Museum of
Zoology in Berlin.28 Schaxel can hardly have hoped for a chair so soon, but he did
manage to exploit the favourable local circumstances to obtain one of the next best
things: his own insitute. Heckel's cantankerous successor as professor of zoology,
the outspoken Darwinist and rabid hygienist Ludwig Plante, made it nearly impossible for Schaezel to use the Zoological Institute. So Schaezel called on Haeckel's associates, whose noses Plante had put permanently out of joint by mistreatment of his predecessor, to support an application for some of the increasingly large sums that the Zeis Foundation was pouring into the University. The physiologist Wilhelm Riedermann and the botanist Ernst Stahl had long been favourably disposed to Entwicklungsmechanik, and the anatomist Friedrich Mauthner used his power as dean of the medical faculty to help a brilliant Jena student and Haeckel intimate obtain a small Institute of Experimental Biology. Plante, as dean of the philosophical faculty, staged a walk-out from the Senate, but Haeckel's crusade was won.

Installed in his institute, Schaezel aimed to provide further evidence against vitalist and teleological arguments with a series of experiments on limb regeneration in the axolotl: he insisted that it was not a matter of replacing what was missing after amputation, but of forming a structure according to the constitution of the stump. He argued that such experiments were theoretically, and perhaps medically, important, but that he distinguished himself from the majority of his colleagues by arguing that experiments were not enough, that biology needed comprehensive theoretical reform. His major work, Grundzüge der Theoriebildung in der Biologie (Fundamentals of theory formation in biology), was finished as he moved into the new accommodation in the summer of 1918. The book articulated concerns about biological fragmentation and specialization that had been rife for many years, but brought it to a new pitch of alarm. In the post-war turmoil many academics were speaking of crises, but Schaezel's analysis was unusually systematic and extraordinarily critical: he relentlessly dissected the contradictions and heterogeneity of biology, explained their historically, and outlined a programme of reform. He blamed what he claimed were the inadequate methodological foundations of Darwinism and the addition to this mosaic of various new experimental disciplines. However, although he still reckoned the reasons for the crisis in biology "internal" to the science, his analysis ramified more widely because he presented it as a crisis in the relations between specialist and popular science. He argued that failure to reflect on methodology had produced internal weakness and heterogeneity. Their science a jumble of poorly grounded theories, biologists had been unable to resist, and indeed had collaborated in, its co-option by popular movements. Now they could offer only to guide the searcher around the "labyrinth of opinions".

In this polemical history, the rift set to when the materialists of the mid-nineteenth century took Darwinism out of the hands of responsible scientists and made truths a matter of "public opinion". Finally safe to bite the hand that had fed him, Schaezel denounced Haeckel's conjuring with the "magical word development" for making a disastrous situation worse. In the second, 1922, edition he stressed the baleful effects of life-philosophy, that intellectual response to the strains of capitalist industrialization which flourished in a Germany ravaged by war. This "anti-science movement" rejected strict science, which was in any case inaccessible. It was, however, the dubious privilege of biology that it looked as though it might quench the
widespread "thirst for the living". Worse, where traditional mechanisms had failed, biologists were themselves picking up this latest "offering from popular philosophy", and mixing their own *novus* experience into their science. * Schaezl was contemptuous of Henri Bergson's "intuitive vitalism", but far more worried that those who considered themselves good mechanists were routinely and unconsciously struggling into supposedly sober science the psychological insights he reckoned should be banished from biology. He even demanded to know.

By what right does the mechanist speak of adaptation and purposiveness, of individuality, of the whole and its parts, of the unity of organization, of harmony, regulation, activity, autonomy, finally even of organisms?"!

Lack of reflection and nervous empiricism meant that great swathes of biology had become a twilight zone of "careless conceptual romanticism". * Schaezl's main targets were, then, those who reckoned they were doing "exact" and theoretically cautious science. But were actually the unwitting prisoners of others' unexamined assumptions, and he attacked these "empiricists" in strikingly similar terms to those Haeckel had once used against the likes of the anatomist Wilhelm His. * But now the treacherous assumptions by which Schaezl reckoned the "empiricists" imprisoned were above all Haeckel's own. And thus we can understand the book as seeking to inaugurate the recovery of a unifying vision of Haeckelian grandeur from what most biologists agreed was the catastrophe of Haeckel's practice.

Experimental endeavours like *Entwicklungsmechanik* and genetics certainly had Schaezl's sympathy. There was no necessary contradiction between doing experiments and being concerned with theory. Theoretical biology was invented to guide and control, not to oppose experiment, and experimental biologists generally stood shoulder-to-shoulder with those who considered themselves modern, experimental, biologists against those they represented as pursuing merely descriptive or comparative studies. But crucially, Schaezl created the most aggressively experimentalist sciences critically too. * Entwicklungsmechanik had not replaced, but rather, he argued, presupposed and joined with, evolutionary embryology. Its practitioners were wrong to think they could just keep their own house tidy, because they had inevitably built on the Darwinians' quickstarts. Their fundamental concept of 'determination', often in the form of an inherited 'determination structure' that was supposed to specify the development of an organism, relied on transforming to explain its own evolutionary formation. But determination was thus burdened with preformationist notions that had been taken over via phylogenetic Darwinsism from the old static morphology. It threatened to deny organisms the history that was supposed to explain it. Attempts to escape this rigidity invoked such notions as 'regulation', which tended to absolutize the organism and make causal analysis impossible. Genetics, by actually investigating the historical formation of the determination structure, might have offered a way out. But in their over-reaction to Haeckelian 'speculation', its "exact" practitioners had ended up forgetting that inheritance was a process bound up with ontogeny, and had produced instead "a
machine without a mechanism [Mechanismus ohne Mechanik]." Schaxel realized that his colleagues would be tempted to continue to sweep these problems under the carpet, but he insisted that the only real solution was theoretical reform to clarify concepts, order the results of experiment and assign each area of research to its proper place.

Schaxel was concerned not just to modernize the biological sciences but, like other professionals after the war, to restore a supposedly lost moral order. He argued that theoretical reinforcement was necessary to protect biology from the outside world. At present, he wrote, the "heterogeneity of the science of life forbids entrance to hardly a thought, however foreign to the subject and to careful reasoning it may be." Biologists and philosophers must use theory to erect such a secure conceptual structure that only the results of properly methodical research could gain admittance. Thus would a genuine science of biology become proof against "extra-scientific influences." Schaxel's contemporary, the immunologist and sociologist of science Ludwig Fleck, considered popular science constitutive of scientific practice: scientific concepts often originated in widely held notions, and the public culture of science depended on communication by vivid icons. In the Grundzüge Schaxel discussed certain related features of the biological sciences, but insisted they must, as the cause of a specific crisis, be eradicated. Rigorous planning would make biology strong enough to withstand the onslaught of those who refused to recognize proper distinctions between science for professionals and the guidance only they could provide others. The general public desperately needed enlightenment, but this communication must be carefully controlled and proceed in one direction only. Attacking the nineteenth-century materialists, he explained that the power of materialism hardly resided in deep thoughts, but rather, in the instinctive, in the emotions, which can be carried into the crowd on some slogans, once the basic mood is there. Democratic conviction and political radicalism always go together with the call for general enlightenment, which has a preference for crude "truisms." There is an aversion to all subtleties, especially of principles, and hence all methodology.

For the purpose of general legislating, which only acknowledges graded differences, the doctrine is perfect that reckons man to the animals, puts him among his equals in nature and thus into the hands of the materialist-naturalist propagandist.

Extraordinarily, Schaxel repeated these spectacularly elitist lines in the second edition of the Grundzüge, and was then himself denounced as just such a character only three years later.

In the disorientation of defeat many biologists and philosophers were receptive to Schaxel's message — the 500 copies of the first edition soon sold out — but he sought to use the book to organize specific and controversial reforms. First, he promoted conceptual criticism and theoretical reconstruction by setting up the Abhandlungen zur theoretischen Biologie (Treatises on theoretical biology), the
first forum for the subject, which more than any other venture defined the new field.\textsuperscript{26} Second, he intervened in the debates about educational reform and biologi-
cal teaching that raged in the early years of the Republic. Complaining that "biol-
ogy" still existed only in name, he was one of those reformers who, a century after
the word was coined, were now promoting "the science of life" as a synthesis.\textsuperscript{27} These projects were linked by his ambitious plans for a theoretical and general
biology, a conceptual framework that would govern the organization of the scien-
tific enterprise, the activity of research, and the communication of its results.

Schaezel still targeted vitalism, but he nevertheless presented Driesch as the found-
er of theoretical biology. He had credited Driesch even in Die Leistungen with the first
great attempt to refurbish an independent biology, and compared to 'a' treatment of
"intuitive vitalism", Schaezel praised Driesch's "categorical vitalism" with faint dam-
nation. Driesch, though, had described himself as contributing not so much to "theo-
retical biology" as to the "philosophy of nature". He held out the prospect of "a
natural science that is in permanent relation to philosophy, a natural science which
does not use a single concept without justifying it epistemologically", but his intel-
lectual aim and personal institutional goal was in fact to "enter the sacred walls
of pure philosophy".\textsuperscript{28} Schaezel insisted, against Driesch and the other vitalist system-
builder, the Kiel botanist Johannes Reinke and the environmental researcher Jacob
von Uexkull, that theoretical work must be firmly tied to experimental practice.\textsuperscript{29}
Likewise, biology to an old building which had suffered too many renovations of
long forgotten origin, Schaezel called for a modern edifice planned and built in a
unified style. But he did not recommend wholesale demolition, nor did he reckon
the new structure could be created by fiat. Theoretical biology must be a continuous
and cooperative project, pursued in close contact with experiment.\textsuperscript{30} No thread runs
through Schaezel's work more consistently than anti-vitalism, but because he was as
critical of mechanical materialism and of hasty applications of physics and chemis-
try as he was of vitalism, the Grundzüge was not read as pushing a particular line; it
rather established him as a critic.\textsuperscript{31} He was not in a position to make taking his side
on burning issues, or even on the nature and purpose of theoretical biology, a condi-
tion of participation in the Abhandlungen.\textsuperscript{32} Schaezel was certainly struggling with
the likes of Reinke and the extremely right-wing Baron von Uexkull over the con-
tent of theoretical biology, but his priority had to be winning biologists and philoso-
phers for the work of conceptual clarification and theoretical order. This critical work
would eliminate speculation and undecidable questions, and so, he reckoned,
allowing struggle of competing theories to produce definitive answers in the end.
The Abhandlungen were ultimately most successful among younger scientists
interested in embryology. Schaezel commissioned Ludwig von Bertalanffy's first
book for the series,\textsuperscript{33} and theoretical biology began in Britain as an import from the
German-speaking world, introduced by J. H. Woodger after he visited Hans Pribram,
one of Schaezel's authors, in Vienna. Woodger translated Bertalanffy's monograph,
got the Cambridge biochemical embryologist Joseph Needham interested in
organicism, and was the main mover behind the Theoretical Biology Club.\textsuperscript{34} At the
end of the 1920s, it was to Schaxel’s Grundzüge that Woodeger and Bertalanffy looked back, not for specific tools but for the most usable description of the situation they claimed theoretical biology would remedy, and it was among contributors to the Abhandlungen that they found those whose work they could present as paving the way for their own.25

The Bertalanffy-Woodeger brand of theoretical biology has been explained as the product of “physics envy” and biologists’ interest in establishing the independence of their science. On this reading, modern-minded biologists used the revolution in physics to break mechanistic materialism, which was making them vulnerable to the disciplinary imperialism of physicists and chemists, and developed an often organicist theoretical Biology to secure a place for biology in the world of unified science.26 Schaxel articulated these concerns very early, but theoretical physics was in 1918 not actually as obvious a model as it might seem with hindsight. Though Felix Auerbach had been an außerordentlicher professor of theoretical physics in Jena since 1889, it was not until the eve of the First World War that theoretical physics in Germany could be considered “a flourishing discipline,” and even then it did nor have the high wows that it would acquire in the next three decades.27 Clearly though, Schaxel relied on its exemplary appeal when he asserted that “we possess no theoretical biology corresponding to theoretical physics,” and even that “theoretical physics based on mathematics is the purest model of general science.”28 This last remark encourages us to look for Schaxel’s resources in much-to-axiomatic mathematics, or even philosophical logicism, as to physics. Suggestively, he spent a good deal of time with the Göttinges school of the modernist mathematician David Hilbert.29 But whatever the model, Schaxel produced theoretical biology in an urgent attempt to resolve what he insisted was an acute crisis in the biological sciences.

Few embryologists were prepared to join Schaxel. Whilst the terrain still needs mapping, it is clear that though the Abhandlungen authors Dreisch, Präzisram, Bertalanffy, Emil Ungerer, Alexander Gurwitsch, Paul Weiss and Eugenius Rüttner agreed that burying one’s head in experiment was no substitute for theoretical reflection, others considered large-scale “theorizing” a waste of time compared to cautiously interpreted experiments. Contrasting Schaxel’s activities with those of Spemann, some eighties years older and the field’s increasingly acknowledged leader, puts the positions of both men into perspective. Spemann, in spite of their earlier disagreement, had apparently been impressed by Schaxel’s theoretical work and indicated his willingness to take part in the project.30 But he did not in fact contribute a monograph and would pointedly call the summary of his life’s work, “Experimential contributions to a theory of development”. Schaxel had praised Spemann’s uncharacteristically theoretical analysis of the concept of homology, but in the second edition of the Grundzüge commented adversely on his description of developmental determination. Terms like “organization centre” and “morphogenetic tendency [lücken, also “striking”] might seem harmless, but could have far-reaching theoretical consequences; Schaxel was reminded of the “realization of the
formative drive of the idealist embryologists". Spemann had other fish to fry, but after this it is not surprising that his monograph never materialized.11 The two embryologists also disagreed on general biology. For Schaezel, general theory would produce such an ordered enterprise that every particular could be assigned a unique place in the conceptual framework, where it would serve merely as an example. He sought a science "frees from the burden of details", in which "isolating abstrac-
tion" would bring out general principles. Spemann, on the other hand, insisted that "even mentally one cannot live from extracts", and defended the cultural value for medical students of a zoology that would be organized by "leading ideas", but would aim to broaden and deepen awareness of the human organism.25

In 1922 Schaezel was a successful young biologist. Some of his colleagues felt he was inclined too much to empty theorizing, others that he was for his 35 years extremely able to take the broad view of the biological sciences that was so desperately needed. He was also a socialist, and worked alongside biological reform for more general reform of the universities. His decisive step was to become a full-time educational official in a left-wing regional government: the disastrous denouement of this gamble made him a nationally notorious "red" professor, and this forced biology and socialist politics publicly together.

2. A MARXIST AMONG BIOLOGISTS

The most prestigious German scientists were university professors, and most pro-

fessors were "translators", the teachers and leading spokesmen (sic) of the educated middle class. Alarm at the consequences of industrialization, they hoped to heal the wounds from a vantage point above the politics of interest. But the First World War, which began with the professors at one in calling Germany to arms, ended not just with crushing defeat and the ruin of the monarchy, but with those who had claimed a mission to unite the nation themselves; deeply divided into two warring camps. By 1918, German nationalist advocates of large-scale territorial annexation faced "moderates" who pinned their hopes on a negotiated peace. All were appalled at the revolutionary upheavals that followed Germany's defeat, and though few went as far as the zoologist Richard Semon, who shot himself in despair as he lay on the now discredited Imperial flag, none was initially able to muster much affection for the new democratic regime. But though the wartime "annexationists" became irreconcilables who would consider only the restoration of authoritarian government, the moderates became "republicans" of reason, coming to terms with the new order by forcing their heads to rule their hearts. The outspoken nationalists were a majority of the professoriate, but they outnumbered the few who declared themselves for the Weimar constitution, and dominated the majority who stood between the two camps. They made the universities bastions of reaction, "an intact foreign body in the lifeblood of the Weimar Republic".26

The mandarins, though, were now having to share faculty meetings with various "outsiders". By 1914 the professoriate was recruiting significantly from the industrial
and petit bourgeois, whose offspring were foreigners to mandarin tradition. These
Harwood has called "outsiders," they understood themselves as experts not as sages:
they were more likely than the mandarins to be politically active, and included
minorities on the left and the radical right. Mandarins certainly regarded the
Nazis as unorthodox, but the German nationalists among them felt considerable sympathy for
their aims, and treated them with uncharacteristic tolerance. More conventionally
considered outsiders, the pacifists and socialists, though like Schaxel often also
outsiders in Harwood's wide sense, were much more fundamentally isolated from
academic political culture than was the radical right.17

Until 1918, declared socialists had been forbidden to lecture in the German uni-
versities. Academics tempted into socialist activity were warned off by the law en-
acted in 1898 to remove the right to teach from the Berlin physicist Leo Atoms. His
faculty and some of the bureaucracy were unhappy about this restriction of aca-
demic freedom, and Arons, as the financial backer of the revisionists, was just the
kind of right-wing socialist the more liberal establishment reckoned should be en-
couraged. But they were powerless in the face of Wilhelm II's telegrammed instruc-
tion that he would not tolerate a socialist university teacher, that "this impudent
scorn of state institutions" must be removed.18 Small wonder that the Marxist
chemist Carl Schorlemmer had worked in Manchester, or that the two scientists
among the widely read socialist popularizers of Darwinism in Germany, the bota-
nist Arnold Dodel and the methodologist of biology Sinai Tschirlock, had chairs in
the liberal haven of Zurich.19

In the Republic, left-wing activity was no longer a sacking offense, and in late
1918 Schaxel joined the SPD and became a member of the workers' and soldiers' counci
in Jena.20 He also increased his involvement in academic politics. An elected
member of the Senate since 1917, he became active in the movement of junior
faculty (Nichternadorien, or "non-full professors"), in which he was from 1919
Chairman of the Association of Non-Prussian Nichternadorien Organizations, and
hence of the Cartel of German Nichternadorien Organizations; he had served for its
first two years as the only leftist on the committee of the Association of German
Universities.21 He may well have reckoned that he was going with the flow. By 1922
the journalist Erich Ewerth was able to count as many as fifty socialist university
teachers.22 But that was only around 1%, and sticking your neck out could still
endanger your job.23 As politics polarized in the post-war revolution crisis,
Schaxel's open socialism was reciprocated by the anti-Republican demonstrations
of the right-wing professors, prominent among them Ludwig Plate. Jena and
Thuringia, the new central German state of which it was now the university town,
was becoming a political battlefield.24

Socialists in the universities in fact had less in common with their faculty col-
leagues than with kindred spirits in non-university research institutes or the free
professions, or indeed the broadly left-leaning literati and artists. Peter Gay's "out-
siders as insiders;25 Beyond the universities, after all, the left was the biggest poli-
tical bloc, and the SPD, excluded from political power under the Kaiser, had become
the strongest pillar of the Republic. But in the aftermath of Germany's defeat the party also sparked a deep split. Now the reformist SPD confronted the revolutionary and increasingly Moscow-controlled German Communist Party (KPD). In a complex re-organization, the SPD also ended up divided against itself. The right of the party tried to jettison Marxism, but Schaezel became associated with the left wing, which insisted from its strongholds of Saxony and Thuringia that a "living" Marxism was still valid. The right supported the Republic unconditionally; the left, though rejecting Bolshevism, put up with the Weimar settlement only as a station on the road to socialism.

Education was under the jurisdiction of the governments of the German Länder, and a left-socialist administration came into office in Thuringia in October 1921 with ambitious plans for radical and anti-clerical educational reform. The education minister Max Greil was determined to include the University of Jena, and took advantage of the retirement of the Kurfürst, the government's representative at the University, not to refill that post but instead appointed Schaezel as a ministerial official in October 1922 (Figure 2). The socialist government was, however, implacably opposed by the rector and most of the faculty, who forestalled a full-scale confrontation over the appointment of new professors to teach the elementary-school teachers whom the government wanted to be trained at the University. Schaezel, as the official responsible, was the pivotal figure in a conflict that escalated into a national scandal. After the rector passed a letter of complaint to the press in October 1923, Greil ordered the University to clear all of its official correspondence with Schaezel, the majority of his colleagues in the Senate resigned by voting to have no further dealings with him. Partly as a result of this conflict, but also because of the entry of communists into the government and the supposed threat of a communist uprising — the stillborn "German October" — the army invaded the state, quashed the government and arranged new elections. Under the state of emergency and a ban on the KPD, the left lost the elections, the new government kicked Schaezel out of the ministry, and he went back to his old job. But there was no going back, either for the rural state of Thuringia, where the left would not be in power again and the Nazis would join their first government, or for Schaezel. He was a marked man, reduced by May 1924 to running the new conservative ministry to complain about a defamatory article. Two thousand university teachers were reading in their trade journal that he had "denied his academic past" to put himself in the service of a "ministerial absolutism," but that "especially intransigent, indeed outrageous," had been his standing silent while the rector was "indecisively insulted" at a "party-political meeting."

Schaezel's political notoriety ruined his relations not only with most of his fellow professors in Jena but also with the leading figures of his most important professional body, the German Zoological Society, in which he had just established a significant role. In early 1922, at his initiative, and as a result of his negotiations with the Jena publisher Gustav Fischer, the Society had launched a review journal, the Zoologischer Bericht (Zoological report), on which Schaezel was one of four
members of the edit() board. For the first two years he did most of the reviewing in his chosen field of "General biology" and his own work was noticed. In May 1923 his position in the Society as he reported on the Zoologischer Bericht as the
annual meeting might have seemed secure. He had, after all, attended every full meeting since 1910, regularly contributed papers at those events, and been largely responsible for the Society's major new publishing venture. But this was to be the last meeting he ever attended. The following summer the Society met in Königsberg, "the furthest eastern outpost of German culture," as an expression of sympathy for its having been cut off from the rest of the Reich by the "shameful peace of Versailles". Schasel was replaced on the board of the Zoologischer Bericht by Ludwig Plate, who used his old enemy's political exposure to take his job on the journal he had effectively founded. Carl Apstein, the editor, and Hans Lohmann, the chairman of the Society, "agreed that this man, who is said to be involved in the Thuringian business and who 'always' works 'against Plate in the red ministry' 'in order to oust him'", could not continue on our board. Schasel's next 'involvement' in the Society's business was in 1926, when at the annual meeting that Speemann hosted in Freiburg im Breisgau his life-membership was annulled.

In 1923, Schasel was a biologist and he was a socialist, but he produced a book at the end of 1924 in which he insisted that only socialist biologists could solve the crisis. In Entwicklung der Wissenschaft vom Leben (Development of the science of life), he brought a rapidly radicalizing socialist politics and his critique of biology together. Of course, Schasel's biology had always been in some sense political; anyone who cared to look could have discovered homologies between his projects of biological and general university reform. But whereas before he had sought agreement or — a keyword in his theoretical biology as in Weimar industrial relations — arbitration (Schlichtung), now he ran up the red flag and insisted that political commitment had to come first. How should we explain this major watershed of his career? It is probable that the man who as a student had corrected the proofs of the people's edition of Haeckel's Die Welträtsel (The riddles of the universe) had for some time participated in freethinking circles, if apparently without breaking into print in his own right. Though I know of no contemporary evidence, it is possible that Schasel was, as he later claimed, already planning a Marxist critique of biology at the time he wrote the Grundzüge. That that work is silent on Marxism might be attributed to its having been tailored to its intended academic audience, but it is significant that it fails to engage even coelexy with Marxist debates and that Schasel's first Marxist work hardly demonstrates long familiarity with them either. What mattered, however, was his public position, and it changing this the university conflict was decisive. The experience of being thrown out of office after a vitriolic press campaign and the intervention of the army surely radicalized him. Reform had failed, and he had every reason to conclude that only fundamental political change could resolve the crisis in biology. His political reputation among academics could hardly be damaged further, and he knew he had no chance of a full professorship, either the personal one he had been promised by the socialist government or any other for which he might once have hoped. But crucially, there had been two audiences for the events of autumn 1923. In the labour movement the same activities that had cancelled his credit with the conservative hierarchy of the German Zoological Society
were, far from a liability, an excellent testimonial.

From now on, Schaxel concentrated on writing for organized workers and socialist educators, but he also addressed *Entwicklung der Wissenschaft vom Leben* to his fellow biologists. In fact, he never entirely gave up trying to persuade them to join him — in the end, he was too optimistically, increasingly proletarianizing would drive them to the left. The book brought Marxism to bear on his analysis of the biological crisis, promising to demonstrate “the material, intellectual and social determination” of biology.

That there still exists in the science of life extremely great ambiguity ... forces us to recognize its dependence, which exists for science [Wissenschaft] as for every product of human activity, on the conditions of production of the respective period of history. The development of biology is extremely instructive, because it gives the opportunity to get to know science as a social product. It contains no eternal truths about life in nature, but reflects human truths from the history of society.51

Schaxel's history in fact added little to this rhetoric; he even managed to describe the rise of modern science without mentioning the bourgeoisie! Within a year he would no longer be capable of such a glaring omission, but what he wrote already made the basic point about historical change in the science of life which backed his claim that,

As organism and mechanism are just forms of expression of their respective social orders for their view of life and the world, so the unclear, blurred conception of life of the present is a product of modern high and late capitalism ....52

Schaxel's crisis remained, then, the same heterogeneity and inconsistency that he had identified in the *Straudiage*, but he now added an explanation of this appalling state of affairs.

The science of life shows its inherent heterogeneity because when organized rigorously, conclusions immediately become apparent which tend to shake the ruling position of the possessing bourgeoisie and its functionaries with respect to the proletariat. So understandably in the science that belongs to the assets of the ruling class, rigorous organization and the conclusions that follow from it remain absent.53

For example, vitalism persisted because it did not disturb the inorganic sciences so essential to the pursuit of profit, but still gave human beings the special place in nature that Schaxel reckoned ideologically crucial for the maintenance of privilege.54 Only socialism could provide the clear planning and interest in the truth that would overcome the crisis.

*Entwicklung der Wissenschaft vom Leben* was reviewed in several academic journals.55 A left-wing minority, like the biologist Paul Kammerer, the botanist Hugo Ilits, Haeckel's vicar on earth Heinrich Schmidt, and the statistician E. J. Gumbel,
answered the call and contributed to the popular-science magazine Urania. The majority of scientists, surely, either reckoned they were 'above politics,' or did not share Schaxel's and so failed to recognize themselves as functionaries of the bourgeos class. Tibor Peterfi replaced Schaxel as general-biology reviewer on the Zoologisches Bericht, and wrote the following notice of Entwicklung der Wissenschaft vom Leben.

This popularly written book is intended to serve primarily workers as an introdution to the biological sciences. In the process party political views are strongly and deliberately pushed to the fore that we must on this occasion abstain from a detailed evaluation of the contents.

Schaxel was branded 'political,' or worse, 'party political'. But he, symmetrically, rejected this label, insisting that his colleagues, or rather the more radical reactionaries like Plate, were the 'political zoologists'. The difference was that Schaxel could be accused of politicking in a scientific publication, but had to make his accusations of bias in the socialist press.

Though some zoologists were keen to exclude Schaxel from positions of power, most were prepared for him to remain a scientist, and content to leave polemics to the radical right. He continued to edit the Abhandlungen until 1931 and published in the Zoologische Society's Zoologischer Anzeiger in 1928. Friedrich Stier, his one-time senior colleague in the ministry, whom he now lived with the Zeiss Foundation as Schaxel himself had done during his brief stint there, told them in the same year that his scientific work was "well regarded", and so the modest funds of the Institute of Experimental Biology were secure. To the extent that his and his political opponents' most obviously "political" activities were performed for minimally overlapping audiences, they could accept each other's participation in science. Sending Entwicklung der Wissenschaft vom Leben for review in the Zoologischer Bericht crossed the line—but from 1924 other academics were no longer Schaxel's main audience anyway. The more centrist socialist professors were oriented towards other republicans in the universities, and also formed an organization of socialist academicians, but Schaxel joined left socialists and communists, the educationalist Anna Siemsen, the philosopher Siegfried Marck and the sociologist Karl August Wittfogel, in reorienting such conclude of intellectuals. They insisted that the truly momentous struggles were those in which they were engaged outside the "bourgeois" institutions of higher learning.

In the remaining nine years of his life in Germany, Schaxel produced hardly any more academic work but wrote a total of five books and twenty-nine articles for the popular-science magazine Urania. Historians of science usually accord such publications, and writing about them, low status. But it is crucial not to prejudge the issue in this way, because the status of writing for different audiences was itself a stake in these struggles. For Wittfogel, to disdain popularization was "the typical sign of a bourgeois 'cultivated' attitude, which can only prevent the popular products of research, but which wants them under any circumstances are too many of the
monopolized secrets of science let on to the "plebs". For Schaezel, producing a certain kind of biology for the working class was the only way to save science — including everything for which he had worked earlier in his career — from practical impotence and imminent theoretical collapse.

3. A BIOLoGIST AMoNG MARXISTS: "COMRADE PROFESSOR SCHAEZEL"

Schaezel was not an "independent" intellectual like the left-wing literati around the Wölbhöfe, but aligned himself with the labour movement. He sought to use Entwicklung der Wissenschaft vom Leben to carve out a niche for scientists among organized workers and socialist educators, making an audacious bid to become the workers' "teacher and the teacher of their leaders". The very fact that a university professor was prepared to come over to the socialist camp was a rare coup, but he was entering an arena where a professor was not guaranteed deference, and deep party-political divisions compounded intellectual differences. Though it was in the unlikely that his involvement in socialist education would be rejected outright, Marxists did give his first popular book a very mixed reception. He skillfully used the poor relations between academy and organized labour to counter socialist resistance and achieve a prominent position. But failed to dictate the terms of participation in "socialist science".

The cultural experts among the defeated Thuringian socialist democrat planned to regain their position by first building the authentically socialist culture within the social-democratic milieu. They started a new popular-science monthly to reassert the centrality of science in natural science to the socialist project. Urania challenged the successful bourgeois Kosmos, copying its format, but lacking social as well as natural science from a Marxist standpoint. The magazine was the regular publication of the Urania Pee Educational Institute; Schaezel capitalised on the impressive pedigree of his personal connection to Haeckel and his courageous demonstrations of partyism during the university conflict to become its Chairman. Entwicklung der Wissenschaft vom Leben was Urania's first book supplement, sent out just before Christmas 1924 to 25,000 subscribers in the network of auxiliary organisations that had long supplemented the trades unions and Social Democracy. These clubs had been built to compensate for workers' exclusion from bourgeois society. Here they could find practical support and pursue an extraordinary range of hobbies and campaigns, from athletics to alternative medicine, or from football to first aid, and here left intellectuals found working-class audiences. Natural science was most important to the "proletarian" freethinkers and the Naturfreunde ("Friends of Nature"). The former were a socialist counterpart to organized bourgeois freethinkers such as the Monat League, the latter a set of intellectual hikers and leisure organization. Though widely regarded as cranks, and unpatriotic with the national leadership of the SPD, the freethinkers and Naturfreunde had a respected place in the left-socialist milieu. For the labour aristocrats who were active in these organizations more than any other socialists, natural science was not only the simplest
political weapon, but also the most important prize. It is well known that Weimar socialism could be extraordinarily scientific; it has not been sufficiently emphasized that the socialists' scientific culture was conflicted. In making a platform Schaezel had to take account of attitudes to science that ranged from eager embrace to outright rejection. Most organized workers who got their views into print were confident that they could use science for their own purposes in spite of its "bourgeois" origins. He sought to convince them that they needed his help. But others absolutely refused to recognize the authority of official science, moving one educator to complain:

Many of us know the anger that grips the teacher when some purely scientific remarks that he makes in "socialist" circles are rejected and attacked ... by the first loud voice to be raised in the discussion, because — all this was "bourgeois science", and is "therefore" unsuitable by the "worker"... [Once one of these discussion speakers believed it necessary to reject even the "atomic theory" of physics as a "bourgeois invention" to "make" the workers "stupid"...]

As the teacher's anger indicates, the right to decide what was "pure" science and what was bourgeois balzus was in dispute. The professor claimed it for Marxist scientists. Schaezel distinguished between "bourgeois science" and science as part of "proletarian culture"; by the following year he would call it "socialist science". "Bourgeois science" was a standard and often rather loosely applied socialist term of abuse for official learning. Engels's literary executor and leading revisionist Eduard Bernstein had argued against Kautsky that Wissenschaft was classless; "scientific socialism", a socialist social science, was, he reckoned no more a coherent notion than the, to him, obviously absurd "liberal physics", "socialist mathematics" or "conservative chemistry"... Kautsky, however, defended the distinctness of socialist Wissenschaft, and Schaezel followed him in arguing that natural science too was determined by class. But, countering radical rejection, the biologist insisted that although the "proletarian culture" would "commit much of bourgeois science to oblivion", it would "at the same time fix the building-stones from it that it needs into its edifice, according of course to its plan"... Appealing to the authority of critical icon Lenin, he argued that it would be "senseless ... to throw the whole tradition overboard": proletarian culture could be achieved only through "exact knowledge" and assimilation of the "culture that was made through the whole development of humanity"... Or in terms of the analogy, the only sensible way to make the worker housing of the socialist future was by re-using a good many of the bricks from the villa of the bourgeoisie. And who else could be the architects but the Marxist scientists, such as himself and the colleagues he hoped to convert, for who else combined "exact knowledge" of science with a committed and critical approach? Schaezel reckoned that only socialism could save science. And, like other academic socialists on the left of the SPD, he rejected those who looked to the intellectuals as its agents; they could not usurp the historic task of the proletariat. But he claimed that
the workers could fulfil their mission only if those “experienced personnel” he later called “special functionaries” told them the truth about nature and society.145 Schateur’s position nearly reassembled flexibility with respect to the academy. Whilst he argued that true scientifi city meant acting as a socialist, by representing the process of constructing socialist science as “sanctifying and filtering” he ensured that the critical programme of the Grunztüge and the Abhandlungen could consistently continue. Certainly, only Marxists could solve the crisis in biology, let alone provide a unified world view, but some “bourgeois science” was comparatively uncontaminated with bourgeois ideology and more of it could be washed clean.146 Reciprocally some scientists who were politically opposed to Schateur were probably pragmatic enough quietly to welcome his attempts to make science palatable to militant workers.

Socialism had often been defined, most famously by Bebel, as Wissenschaft applied, and Schateur made this licence his claim but only Marxist scientists could safely interpret the socialist project. The education provided by the state and many of the independent initiatives that socialists had been prepared to patronize would not help realize “proletarian culture”, but was, in fact, worse than useless. He attacked specific “bourgeois” theories — vialism, any hints of religion and right-wing racial anthropology most prominently — but also put a new spin on his critique of biology as a contradictory jumble: this “diversenary science” served to distract workers from the essential knowledge they needed.

Dull so-called enlightenment, recovered from the educational leanings of bourgeois society, is being picked up by proletarians thirsting for education. It is not merely that this sort of thing is of no use to them in the fulfillment of their historic task; rather, they are being distracted from the battlefield of the class struggle to miserable playgrounds, where the swirling of the cultural fog of the bourgeoisie blocks the view of the high ground of freedom that remains to be climbed.147

Schateur was like the socialist cultural experts who tried to wean workers off literary “trash”, and the epitome of “trash” science must have been Kosmos-author Wilhelm Bösch’s extraordinarily popular reveries. Schateur prudently did not take on Germany’s best-selling non-fiction writer and eloquent defender of the rights of the “freelance popularizer but the professional purveyor of “rigorous” science was fundamentally at odds with Bösch and his whimsical representations of nature as “a giant gallery of beautifully coloured erotic paintings”.148

Schateur remained true to what he had written in the Grunztüge on the relations between science and popular science, including his diatribe against the “materialist-naturalist propagandist”. It reappeared, re-worked of course, in Entwicklung der Wissenschaft vom Leben. He still accused the “vulgar” materialists, and by extension many freethinking and socialist writers on science, of peddling the false comfort of “shallow enlightenment and superficial general comprehensibility”. But now he criticized them for bad strategy: picking out politically congenial theories would not do because it never failed to bring a backlash.
Just when democracy seemed "based on nature," the same "proofs" of the struggle for existence and survival of the fittest are used for a naturally necessary and God-ordained aristocracy.... [B]ourgeois scholars are still fighting reality with props from the Darwinist lumber-room.28

A great deal had changed since a previous generation of scientific radicals, but not enough for Schaxel. He insisted that socialism needed to learn that science had both progressed and — his major innovation with respect to previous socialist theoreti-
cians of biology — become much more problematic since their parents’ day. Marx-

ism was securely founded in biology, but the exact nature of those foundations was now unclear, and would remain so unless committed specialists got to work.

Compared to the fluency of Schaxel’s later socialist writings, Entwicklung der Wissenschaft vom Leben was awkwardly constructed and stylistically problematic. But the tensions and ragged edges in his first major effort, and the problems readers had with it, are especially instructive, because they show us how difficult it was for a socialist biologist to find his way between critique of the present state of science and his interest in arguing that a reformed biology must be at the heart of the socialist—

ist project. I shall examine how Schaxel’s book was received by socialist and other reviewers. It is certainly an important, though perhaps an unanswerable, question, what the mythically ‘ordinary’ worker might have made of it. But the rather select band who set the tone of social-democratic activities were often out of touch with the majority of party members, let alone voters. What in fact mattered to Schaxel’s secu-
ting a position was, most directly, the opinion of leading functionaries and educators.

Entwicklung der Wissenschaft vom Leben won lavish praise in several socialist publications. The magazine of the Workers’ Radio League, for example, puffed Schaxel’s “extraordinarily important” book:

We call special attention to this investigation not least because the author as a well-known socialist is not content with the usual bourgeois-scientific dogma-
tism, but with reference to Karl Marx tikes new and for the workers’ cultural movement very significant steps.29

Urania was quick to deploy the accolades. This is what an Urania reader in a prominent position in political life wrote to us after reading Schaxel’s book: “... The scales fell from my eyes. Frankly I had till then not yet seen the justification for Urania.... Now the point of your programme has become quite clear to me; in this manner and only in this manner can humanity be given education capable of affecting and promoting cultural striving founded on a free world view....”30

Positive reviews built up the professor’s reputation, but the reception of his first major effort was by no means as simple as the eulogies imply. By Schaxel’s own lights, after all, it was not an easy task to write accessibly about a subject that was still a chaos of competing theories, of which the most vivid
concepts were hopelessly contaminated and confused. But could he not simply have taken as a model his one-time supervisor Goloschmidt's highly successful *Ascaris*: Eine Einführung in die Wissenschaft vom Leben für Jedermann (*Ascaris*: *An introduction to the science of life for everyone*), which had come out two years earlier?! Like Schael, Goloschmidt, now head of a department at the Kaiser Wilhelm Institute of Biology, represented modern experimental science. But he adopted an avuncular persona to make "everyone" the object of familiar, chatty and anecdotal instruction. The book was named for the roundworm, and Goloschmidt masterfully spun his didactic narrative around observations on this intestinal parasite, using the reassuring style of the *Pfändler* (chat) to make this impolite topic respectable. But though Schael had welcomed his supervisor's book, his purpose were different, and he rejected Goloschmidt's style for a reason. Schael wrote a combination of textbook and political pamphlet, enthused only by occasional flashes of humour. He did not chat and he told no stories; no one could accuse him of meaning digressions or casual analogies. For these there would have subtended his message. He was writing not for "everyone", but for biologists and socialists; he too aimed to enlighten his readers, but he did not want to divert them.

"Bourgeois" reviewers praised this "extraordinary clarity and discipline [Schulung]" in the sections of Schael's book that dealt with biology, but disapproved of how it gave way to "inaequate and unclear conceptions" as soon as he turned to society and politics. That was predictable, but more importantly, the contents of the middle sections in which he presented "The conceptual framework" actually reflected the little socialist comment. Here he distinguished knowledge of life derived from introspection as the business of psychology from knowledge of living things, which was the proper domain of biology. He delineated two groups of phenomena, the succession of individual beings due to reproduction and their sexual association, and accordingly divided the science between the "order of being" and the "determination of development", preceded under the headings "formation", "behaviour" and "relations". This may have been a step towards a rigorous, materialist biology, but socialist reviewers could not see how it would ground their political project; it was, I have argued, an important part of Schael's message that much of the work remained to be done before that would be possible. On the other hand, socialists could see that Schael had rejected the tried and tested techniques of science popularization. He had put in examples and illustrations, but even some sympathetic reviewers reckoned the book too dense for workers. His enemies were less polite. He had criticized Plate for smuggling affective expressions into supposedly mechanistic biology, and for preaching politics in his lectures. Now, in a situationally hostile review in the *Journal* of the German Society for Racial Hygiene, Plate lampooned Schael's incomprehensibility. He supported his assertion that "the author ... possesses a strange ability to cloak quite simple concepts in a jumble of words" by quoting a sentence that he pointed out made up an entire one-seventh of Schael's section on "Sex":
The determination of formation leads in pursuing its direct course to connec-
tions, which individual beings in certain states of development make with oth-
ers of the same kind, and which thereby lead to association [Neneinander],
the other basic phenomenon of life besides succession [Nach einander].

In context, this might have come across more easily, but it was not difficult for Plate
to make political capital out of his opponent’s style.

The best Schaxel could do with critical responses from socialists was probably to
try to learn from them, but Plate’s animosity could be turned to advantage. Urania
skilfully explored the difficult relations between academia and labour movement,
beginning a review of reviews by bolstering Schaxel’s academic authority.

Bourgeois science today is characterized by its fear of conclusions. No longer
strong enough to suppress emerging truths, it reverts burning question open
and timidly does not decide what is truly actual. The present-day science of
life with its bewildering confusion of contradictory theories is a good example
of the scientific enterprise of a dying class. In the first Urania book supplement,
Entwicklung der Wissenschaft vom Leben, Professor Julius Schaxel, with
Marxist rigour, outlined...the preconditions, content and consequences of this
situation. He was consistent to do this as no one else; for he has produced a
great work, about which the Karlsruhe scholar E. Ungersch writes: “The best
introduction to the jumble of theories and problems, which present research
into life represents, is J. Schaxel’s Grundzüge der Theoriebildung in der
Biologie.”

Then, in its second move, this meta-review used the socialist commitment that
Schaxel had shown in Entwicklung der Wissenschaft vom Leben to expose the preju-
dices of the same learning world. In an unusually explicit example of Pierre Bourdieu’s
“cases of perfect inversion”, it presented a couple of negative reviews as ludicrously
prejudiced, one person’s “strain” had actually become another’s “cost of arms”.

In this game, the worse the review, the better it was. So Plate’s venomous response
was Urania’s trump card. He makes the discovery that Schaxel addresses himself to “social democrats and communists”. He reckons that “the presentation is made appeasing to the con-
radises by references to the importance of proletarian culture, by lots of quotes
from Kautsky, Trotsky and other red saints, mostly of the Jewish race.”

Juxtaposition with the egregious Plate put their man in the best possible light.
In fact Schaxel attempted to construct a frankly heroic role for socialist scientists by
demystifying their persecution in the universities. He wrote an obituary for
Kasmirer, the progressive neo-Lamarckian and Urania author, who committed
suicide in 1926 after his experiments on the inheritance of acquired characters were
claimed to be fraudulent. Schaxel reckoned that “cowardly slander” and “malicious
incitement” had put the wespot in his friend’s land, because
Kammerer’s gift for presenting what he had researched and seen with inspiration and insightingly made him, who was more like a brilliant artist than a busy scholar, widely famous. For many "colleagues", especially some personalities comfortably dosing on their chairs, he always remained just a "Jew" and "socialist", whom they did not need to take seriously and who especially must not be allowed to come up in the world.

Kammere’s true crime was having drawn freethinking, materialist conclusions from his work. Actually, he remained so much the West European scholar that he wanted to steer clear of political consequences, but his revolutionary spirit kept breaking through. "And", Schaxel thundered, "it was the revolutionary pricking to the surface that the official science of the bourgeoisie had to bring down." But Kammerer had not died in vain: "One falls, the mass rises up!" Schaxel himself emerges as the leading drayer of uncomfortable conclusions, hampered by neither the martyr’s estimations nor his "artistic" side.

Among socialist cultural producers there were very few university professors, but a much larger group of schoolteachers and worker-functionaries. People of such different status could collaborate in socialist science education by affirming their common political commitment. But Schaxel made socialist scientists into heroes, and deployed a scientist’s resources, to distinguish himself from the others. His institute had become more useful to him as a symbol than as a site of experiment, and he generally had himself photographed in his laboratory. The Urania Press presented readers who bought in 1927 diary with an image of Schaxel similar to that shown is Figure 3. He appeared on the same spread as a photo of Freud, and belonged in such exalted company because he was one of "the pioneers of a modern biological research, who also draw the necessary… conclusions from their results." Schaxel himself insisted that science could be popularized accurately only by "work, directly from the sources", and as if to demonstrate his unmediated contact, has plates of his experimental results bound at the front of Entwickler der Wissenschaft von Lehen. They announced that the author was someone who could do experiments of his own, but lest the point be missed, he wrote that the educational worker… may not be a mere go-between at second or third hand, who lightly passes on what he has superficially acquired. Otherwise he runs the risk… of anesthetizing the proletarian seed for education instead of satisfying it.

With his "Professor Dr" taking up as much space on the cover of the book as his name, Schaxel shared with scientist-popularizers on the right the dream of getting rid of the intermediaries, of taking control of communicating science to their wider publics.

This blatant pitch raised hackles. Adolf Laut, a leading functionary in the Naturfreunde, paid Schaxel the back-handed compliment of denoting two thousand words to trying to rescue his "extraordinarily valuable" conception from its having been produced without regard to the knowledge it could be assumed workers would
bring to it. He explained that many a Naturfreund who had excitedly awaited the first Česmsia book would put it down disappointed, "for he had expected to receive here good and yet quickly comprehensible science", but would find instead that understanding was made "extraordinarily hard". Lau was diplomatic, but he
interposed himself as an intermediary, demonstrating the importance of pedagogic skill, and bursting the bubble of Schael's fantasy of unmediated communication. He presented a selective interpretation of the professor's arguments along with suggestions for further reading on various points. In some respects he may have acted as a 'multiplier', but by the time he had finished with it, the essence was no longer the same. He did rather insightfully translate Schael's strictures on not seeking easy 'proofs' of socialism into the injunction that fact must come before value, first the "purely scientific moment", then "the psychological", the "evaluation". But nothing remained of the supposedly unique ability of the scientist to provide knowledge of things that was rooted in things.

Others went much further than the conciliatory Lau. August Thalheimser, the leading theorist of the Communist Right, reviewed the Kantsky Festschrift, to which Schael had contributed a chapter on "Marxism and Darwinism" just before writing Entwicklung der Wissenschaft vom Leben, in the international communist journal Unter dem Banner des Marxismus. As far as Thalheimser was concerned, Schael was swallowing in the same swamp as the other exponents of "petty-bourgeois socialism" on the left of the SPD. Sure, Haeckel had been a "bourgeois-democrat" and turned the struggle for existence against the working class.

But in his science he was a firm, even a valiant materialist, and we won't let Haeckel's natural-scientific materialism be blackened because of M Schael's declaration of belief in the Kautskian brand of socialism. Thalheimser found nothing that was Schael's offering to persuade him to give up Haeckel and the old materialists, and he ridiculed Schael's history and philosophy of science. A more differentiated approach was needed than the biologist's complaints about Darwin's "bourgeois economics, or his desire to eliminate "struggle for existence" from the scientific vocabulary because Materialists had missed a term which simply described "a fact of observation". He would be rejecting that other bourgeois product, the infinitesimal calculus, next Schael was struggling to find a solution to what he regarded as an unanswerable debate between mechanism and vitalism and cautiously to bring this problem to the attention of fellow socialists, but to Thalheimser he was just a closet "anti-materialist". And, worse, was asking him to exchange nineteenth-century achievements that were perfectly good if you knew how to use them for "the sum of bourgeois, reactionary drivel of the twentieth century", which he could not distinguish from "sanctimonious sophistry" and "spiritualistic clichés".

These responses to Schael's most problematic publications bring out the difficulty of what he was trying to do. The range is instructive. Thalheimser was quite happy with the biology he already knew, and knew how to deploy, and saw no need to take on Schael's agnotizing complications, which just seemed to muddy the waters. He was utterly unperturbed by Schael's claims to special authority, and as a Communist he anyway did his best to find fault with a social democracy. The fans, on the other hand, give the impression less of having been won over by the argument
than of valuing the professor as a trophy. The more differentiated socialist responses were critical, but these reviewers, like Lau, welcomed Schaxel's efforts while refusing to cede their own competence to interpret science.127

Within these important limits, however, the professor's exploitation of his unusual position had established him among precisely the left-wing social democrats Thalheimer despised, and he could now make his way to the next book. Urania's review of reviews ended by referring to Plato's complaint that Schaxel's section on "Sex" spanned only 35 lines.

Well, he can find the sexual enlightenment that by his own admission he lacks in the first book supplement of the third volume of Urania, in which Professor Schaxel deals with Phenomena and determination of sex, of course again not a gift for bigots, but rigorous natural- and social-scientific enlightenment.128 Schaxel had used a conference of socialist educationalists and cultural politicians that he organized in 1925 to take over writing position statements for Urania, and when the founding editor, the teacher Ernst Mühlbach, left in 1927, he occupied the tailor-made post of "scientific director" (wissenschaftlicher Leiter). This must have given him considerable editorial power, but the magazine was still a forum, and his own articles the most radical. Nevertheless, Schaxel was far from a one-man-band. In addition to the handful of progressive scientists, Urania attracted a host of science writers, reforming physicists, socialist cultural politicians, psychologists and functionaries. Their contributions made for a healthy programme of science, class struggle and lifestyle reform, represented for many by the name "Schaxel".129 Now he was secure enough not to push so hard for a privileged position. A broad coalition of socialists was organized around natural science as a political issue, and he had become a figure of acknowledged authority among them.

4. PRODUCING "FIGHTING KNOWLEDGE" FOR THE "PEOPLE OF THE FUTURE".

Over the next few years, Schaxel immersed himself in socialist cultural politics. Having originally come into science via Haeckel's free thoughts, he became especially involved in the activities of the proletarian freethinkers, and held office in the Thuringian district of the German Freethinkers' Association (Deutscher Freidenkerverband). prolific in print, he was also active in broadcasting as Gaulsteiner of the Workers' Radio League in central Germany. Immediately after the launch of the Urania project, he visited the Soviet Union for several months and brought important resources home. He used the trip to establish a more flexible position with respect to the parties of the left, and also made the "New Russia" a working model of the dominant role he sought for science and for scientists. And this he attempted to prefigure as he propagated for biology as the foundation of socialist practice and ideology in the distinctive scientific culture of the socialist freethinkers of Germany.

Schaxel was distant from the pressing concerns of most party members. Gerda
Groll, from 1929 an apprentice clerk in the SPD press where *Urania* was produced, recalled that the social gulf was inevitably considerable.

Schazel was a progressive scientist... he had his materialist world view, but he was always the man of the upper class... Not, "I want to be detached" [Distance],... but he couldn’t be anything else.

In spite of his being so "well-groomed, you might almost say conservatively-dressed", Groll and others described him as "open", and he was a hit explaining the facts of life to the Socialist Workers Youth (*Sozialistische Arbeiterjugend*, SAJ). He contributed to the economy of the socialist cultural organizations by becoming a sought-after speaker, a 'draw' who gave dozens of educational talks to freethinkers, *Naturfreunde* and young socialists, and was also a source of useful contacts. But the functionaries, like Karl Brandig of the Jena *Naturfreunde*, worked out a programme and then asked the professor to speak. He would talk over with them what he might say, but came along at the appointed time, said his piece, took part in the discussion and then left. His distance from the day-to-day life of the movement was, however, not just inevitable: it was strategic.

Most important, it meant that Schazel was aloof from the faction fights that he, like other left intellectuals, never tired of lamenting divided political energy into fruitless internecine strife. But much as many of the battles that so absorbed functionaries’ attention were not Schazel’s, if he wanted to be listened to, he had to negotiate them carefully. On his return from Russia he gave a series of extravagantly pro-Soviet lectures, which attracted enormous publicity and got him into trouble with the local social democrats, but were lapped up by the communists. Joining the KPD was never a real option for Schazel: he would almost certainly have forfeited his university position and, especially after the ultra-left turn of the Comintern in 1928 split the socialist cultural organizations, access to the much larger social-democratic rump. But he had previously been too firmly identified with the SPD-left of Groll and the cultural politicians he worked with on *Urania*. The way he used the Soviet trip weakened his disabling association with a particular faction.

Schazel’s line would remain basically as he had set it out in *Entwicklung der Wissenschaft vom Leben*, but he came back from Russia with sharpened Marxist vocabulary and analysis. Now the "pathetic wriggling" of the "undecided-vasillating, pussey-footing, hinting, euphemistic" language that Thalheimer had found so disgusting was gone. To future Schazel received far more praise for his accessible and gripping language than he had got brickbars for *Entwicklung der Wissenschaft vom Leben*, though some social democrats did find him doctrinaire. His name was invoked in the local KPD paper as an authority even on matters very far from the development of the science of life. At a meeting of the Jena *Naturfreunde*, a social democrat had objected to Moscow’s extremely controversial decision to invite professional "bourgeois" chess-players to the Soviet Union. But
It was explained to him that the government of the Workers' and Peasants' State Hải, in its correct understanding of the great importance of the game of chess to the working class and cultural progress, arranged this match for reasons of propaganda, with the successful result that today in Moscow alone 2,000 workers' chess clubs number 65,000 members. Soviet Russia just is, as Prof. Schaxel confirmed, in cultural politics the leading country in the world. 193

Schaxel, who rarely pronounced on current political issues, had reinforced his claim as a biologist and freethinker to provide a "socialist science" above the struggles of the day. As Brundig put it: 194

[Since he was politically not very tightly tied to the one or other party, he had enough freedom of movement. Basically he was a left-wing social democrat; others said he was a communist. You could get that impression from many of his speeches.]

A regional conference of the Thuringian Naturfreunde gives a good example of what this freedom meant. In a nationally scandalous move the leadership's slate was voted down, but reports ended with praise for the lovely talk by the Comrade Professor. 195 His aloofness gave him access, but he did run the risk that he might be invited to entertain and just the tone once the serious cut-and-thrust was over.

The first socialist state became an extremely important model for Schaxel. He confidently pointed to the "first great, durable attempt to realize the unlimited possibilities of socialism under the dictatorship of the proletariat" as evidence that History was on his side. He also now projected the proper relations between scientists and the wider society, and between specialist and popular science, in terms of "Science in Soviet Russia". Science was rigorously planned. Equally important, it was becoming "the common property of all members of society" and tolerated "no separation of strict scholarly and popular cultivation". In the Grundzüge Schaxel had been concerned to erect barriers to protect biology, to enforce clear distinctions between popular and specialist science, so that biologists could offer public instruction from a position of internal strength. He now argued that the Bolsheviks had not only banished the threat that the decadent bourgeoisie had posed to strict science, but put scientists in charge of the channels of scientific communication. There was a graded series of scientific literatures for people of different educational levels written by scientists or at least "from the sources", and so informed by the same principles throughout. Alongside research units in every enterprise and the full integration of biology into the process of production, the means to form a scientific socialist world view were now available to all. 196

In Germany, Schaxel reckoned they could build this future in earnest only once the proletariat had taken power, but the preparations had to begin before the revolution. He claimed the task of "sifting and filtering" the bourgeois heritage, arguing that what he rescued would form both the knowledge that the proletariat would use in its struggle for liberation, and the germ of the socialist science of the future. He spent a good deal of energy attacking "bourgeois science", but he concentrated on
showing that two-sided, materialist explanations were possible, and that these would take the socialist beyond the limits of knowledge to the terror of bourgeois truth. He wrote and spoke about many different subjects. The disciplines that were so important in the universities did not matter here, but the topics included his own field. The human embryological description of the sea reformer and Urantia author Max Haudans was put out in order to solve a more immediate concern in his Urantia readers' limit regeneration in the axolotl, but research in embryology was widely understood as addressing burning issues of world view.

And writing about his own work reinforced the professor's status.

Schaxel took specific, and in some cases quite specialized, conflicts in which he had been involved in embryology and theoretical biology, and sought to enlist organized workers on his side. He contributed a piece on "Life and form" to Urantia's very first issue, concluding that materialist science, provided it avoided the rigidity of mechanism, would solve the problems of development. And when he presented his own experiments in "Regeneration or substitute formation?" he claimed to eliminate vitalism, and held out the prospect of further advance by concluding that, "[w]hat is missing is not formed again in some mysterious way, but in the course of development, in accord always with what is present, new structures are made." (Figure 4). Schaxel was read as having shown that the formation of an individual was not absolutely determined in advance, but that changes were possible, and that this opened the way for humanity to control life just as it already controlled matter.

These articles, though certainly controversial, would have been strikingly less out of place in the German Zoological Society than Schaxel's polemics. He had more or less called the last part of "Life and form" from an article in the Archiv für Entwicklungsmechanik, but between the covers of Urantia the same sentences and images acquired a greater political charge. The Archiv remained within institute libraries and studies; some of the one-hundred-fold more copies of the socialist magazine ended up in the rucksacks of revolutionary hikers.

Much the most important knowledge as far as Schaxel and Urantia were concerned was the evolutionary alternative to the Biblical narrative. It explained to organized workers how humans had evolved through the struggle for existence, and how socialism would develop through the class struggles of history. In an article that appeared in spring 1928, he encouraged his readers to collect frog spawn from ponds and watch it develop in a glass container by a sunny window.

In the course of three months he concluded from simple cells, via water-inhabiting tadpoles to develop four-legged air-breathing frogs. In part of a year we have followed a series of events that, when it occurred evolutionarily in the development of life, took millions of years.

This was a standard, even hackneyed, series of observations, but in the pages of Urantia the old ontogenetic proof of phylogeny demonstrated the natural necessity of socialism. Schaxel's problems with the biogenetic law were beside the point here; fighting with the right wing of the Munich League for his teacher's mantle, he claimed...
that Haackel was to be placed “in the series of intellectual ancestors of socialism”.

This knowledge that Schaeze reckoned most essential, the “fighting knowledge” (Kampfwissen) with the aid of which the proletariat would recognize the reality of its position in nature and society and so change it, he put in his Menschen der Zukunft (People of the future). It was a very special kind of book, endowed with potentially enormous significance by presenting it to young people on one of the most important days of their lives. The socialist freethinkers, making their own ceremonial culture as an alternative to that of the churches, promoted a secular confirmation, the Jugendweihe. Rather than admitting the young adult to the community of Christ, they welcomed him or her in a mass school-leaving ceremony into the ranks of the organized working class. The high point of the proceedings was a speech, at the end of which each child was presented with a small but improving book.

By this time, 1929, the Jugendweihe book was already a standard genre, but until now the freethinkers had lacked, one of their own. Menschen der Zukunft was produced in agreement with them to provide “the materialist catechism”,

FIG. 4. "Double formation after complete removal of the left hindlimb" of an axolotl (belly view). This image was intended to show that depending on the particular conditions of the operation, scientists could produce "nothing, too little or [as in this case] too much”. What was missing was, Schaeze insisted, not replaced by some mysterious and vitalistic regulation, but new structures formed according to what was present. Not an idealized representation but drawn from a specimen, the vermiformite of this picture made the point that not detail of what developed mattered. From Schaeze, "Wiedererwachung" (ref. 173), 174.
Schrader's Marxist version of Haeckel's natural history of creation. The linen-bound volume consisted 62 pages of large type, including nine full-page pictures, in which Schaxel promised his "young comrades ... the guidance which leads from the natural history of humanity to the history of human society, to the readiness to act, to the act itself." 92 The book was divided into three parts, Past, Present and Future, themselves split up into short sections headed by quotes from Haeckel, Marx, Engels, Rosa Luxemburg and Bebel. Here was a complete developmental story in easy language that the freethinkers could give their young people. It was widely advertised and generously praised in the freethinking press and in the magazines of the Naturfreunde, and regularly given at Jugendweihen. 93

In Jena, 220 youths received Menschen der Zukunft at the annual Jugendweihe on Sunday morning, 24 March 1929. The children who took part would generally have come from social-democrat and communist families who had previously taken them out of religious education and registered them instead for lessons given by freethinking teachers. The Jugendweihe itself was the culmination of months of weekly classes in several schools and also a few special lectures for all participants: in 1929 Schaxel spoke on "The development of human beings in society" and was followed by others discussing "The Peasants' War" and "The meaning of proletarian celebrations". 94 The Jugendweihe took place before parents, relatives and the others who had been encouraged to attend: "Older workers must show ... that they accept the young comrades-in-arms enthusiastically into their fighting ranks." 95

The choirmaster opened the proceedings with an organ prelude and then directed the Jena People's Choir in an uplifting song. The communist teacher who had been supposed to give the speech had so savaged the social-democrats at the annual conference of the proletarian freethinkers in Jena - at which Schaxel was re-elected as second chairman - that they had declared him unfit. 96 So the teacher Zimmermann from Ruhla near Jena spoke instead. He compared adult life with a sea, on which, when the rising sun melts the snow on mountains and in the country, a great number of Columbuses set sail to discover new land ... Working-class youth does not sail on the ship of wealth equipped with every luxury and comfort, but on that of poverty, on which there is not enough. Workers' children learn at an early stage to see that there are two classes ... Of the point of this rite was for them to affirm their allegiance to one of them:

Today you are being introduced into the adult world, the world of the proletariat, to which you will henceforth belong. Here are your class comrades, a firm, iron mass, into which on this day you are received. May you now confirm with a handshake that you will serve this mighty army of all workers with the strong power of your youth.

As they shook Zimmermann's hand, in the moment when they were individually the centre of attention, the young people were presented with copies of Menschen
As Germany plunged deeper into economic and political crisis, Schaeel rejected the liberal republicanisn of the Grundzüge, and denounced in ever more apocalyptic terms the inability of "bourgeois science" to provide a world view. Haackel had been its "true hero," 144 Now there was not just chaotic eclecticism, but the danger of something much worse. Historians of Weimar science have understandably focused on this threat from the right. But up until the end of the Republic millions of Germans fully expected that the radical left was about to complete the unfinished business of 1918. Schaeel worked to provide them with a biology for this socialist future.

Following Luxemburg in lamenting that the very conditions so brilliantly explained by Marx had meant that his theory could for a long time not be properly developed and applied, Schaeel reckoned it important to go beyond "fighting knowledge". So he set about applying dialectical materialism to natural science. He claimed that he had intended to put "mechanical materialism in dialectical motion" since 1906, but more plausibly that he had begun in earnest only when he helped prepare Engels's Dialectics of Nature for publication on his first Soviet trip.145 He started publishing his attempts to construct a "dialectical biology" in 1929. Cautions about legislating for a science that could be built only under socialism, the dialectical biologist retained the critical perspective of the Grundzüge. But in adopting the "dialectical method" he now commited himself to a philosophical position from which he claimed it was possible to grasp the general relations of biological phenomena and so to resolve the crisis of biology. And he used the dialectic to draw together the various strands of his dynamic biology into a self-consciously collectivist philosophy of nature.

The most fully worked out example of the sed professor's dialectics is an article on "The biological individual" that he published in the logical positivist journal Erkenntnis after giving a talk on 25 February 1930 to the Empirical Philosophy Society in Berlin. Just as his Comrada comrade Anna Siemens's pedagogy sought to overcome individualism, so he criticized the biological concept of individuality. The problem, he reckoned, was a problem of bourgeois society. That was why it was always posed but never solved. In fact, the biological individuum was being historically, genetically, formally and socially dissolved. In his theory of development in successive acts, for example, form was neither predetermined nor did it
develop towards the fictive individuality and totality peddled by those who mistakenly spoke of regulation. And socially, in the most advanced species, individuality was being overcome in the collective.

In a sardonic and probably solitary moment, Schaxel speculated on human relations in a world without individuality. In "Social eugenics and erotic collective" he imagined that "[a] society that will have arranged its relationships other than to serve the property relations of individua" would forget "personal love with other accompanying phenomena of... exploitation". But "[o]nly when the last bourgeoisie has been exterminated will the human individual die out and personality no longer have any meaning". He was not particularly interested in reproduction; eugenics would deal with the business of "planned genetic industry" somehow. "The people of the future" would have "food, shelter and work" instead of "private property", "religion" and "bedroom secrets".

Love ends. It occurs to no one to want to possess another. There are no motives for jealousy. Should eroticism remain, it will be a component of the physical culture of leisure. It has its appointed time like every other mass sport to compensate hygienically and prophylactically for the partial activity of the body consequent on the division of labour. The capitalist breeding ground of flirts [Kokken], prostitutes and priests [Pfaffen] is removed.

In his own numerous sexual liaisons with women, Schaxel claimed to have prefigured the disappearance of love. But he wrote, "I was alone as a boy and have remained so as a man".

Schaxel sought especially to convince young scientists that whereas "empiricists" and "metaphysicians" would not find their way through the chaos, "dialecticians" would reap a rich harvest. The University of Jena had become a centre of fascist agitation, but Schaxel lectured to students on dialectics and on "Marxism and Darwinism": apparently without disruption. His activities were followed with interest not just by the logical positivists but by some members of the Frankfurt Institute of Social Research. It will be important to find out more about how other established German scientists treated him by this time, but it is unlikely that any were tempted by dialectical materialism. For his part, Schaxel followed Engels in claiming that there were two routes to understanding the dialectics of nature: the easy way via knowledge of the laws of the dialectic, and the hard one through scientific research itself. Schaxel knew enough of his colleagues' social being to have realistic expectations of the numbers who might take the high road, but he supported his claim that dialectical biology had a future in Germany by pointing out that scientists he admired, such as the right-wing Richard Goldschmidt, were actually turning into dialectical materialists, if "no doubt without becoming conscious of it". This raises the long disputed but no longer urgently asked question, to what extent dialectical materialism has offered biology: a real, let alone a viable alternative — and might aid the construction of a liberatory one.

That Goldschmidt could exemplify good scientific practice shows graphically how little "dialectical
biology" represented some kind of "rupture" with "bourgeois science". Schusel did, however, stand for distinctive theoretical postions. for the sub-discipline of theo-
retical biology, and for the planning of every aspect of the science along lines that
torified his mandarin colleagues.

Though he appealed to them, Schusel did not rely on German biologists, and nor
can historians assess the range of alternatives for biology in the last years of the
Weimar Republic by focusing narrowly on "the German scientific community". He
looked beyond Germany to the Soviet Union, and he looked beyond scientific insti-
tutions to the organized working class. More even than, for example, the Vienna
Circle Schusel produced for audiences outside the academy. But even in Erkenntnis
he declared that

A social stratum, forced on to the defensive, erects the ideological dictatorship,
which aims to prohibit the empirical access of offensive empirical experience.
The validity of every ban is a question of power. Crucially, it was because Schusel recognized that the success or failure of his project

of scientific reform was a question of political power, and not just a theoretical
debate, that he took his work in the labour movement so seriously. By the last years
of the Republic he had ensured that biological reform was on socialists' agenda,
and pinned everything on winning.

When, however, we do venture beyond scientific institutions it becomes impos-
sible to take at face value Schusel's own account of his actions, in which, quite
simply, he led the enlightened vanguard to certain victory against the forces of
 darkness. First, the labour movement culture in which he worked was not only
under siege, it was also deeply divided against itself. He was not, in spite of his
claim that workers were naturally materialists, simply articulating some proletarian
common sense. The effort that, we have already seen, he put into steering a middle
course of critical appropriation between rejection and acceptance of "bourgeois
science", and his repeated insistence that neither religion nor going "back to na-
ture" would solve the ideological crisis, is a measure of the opposition. For all the
strength of the freethinking milieu in Saxony and Thuringia, by no means all of his
"spiritualists", "quacks" and "metaphysical" enemies were outside the Marxist camp.
Second, this rigorous scourge of mysticism himself participated in practices in which
science-nature was not so much analysed as worshipped. I shall explore these con-
tradictions, and draw together the main points I have made about his work in the
labour movement, by finishing with an exploration of the high-point of his career as
a ceremonial speaker.

In 1931 Schusel gave the "fire speech" at the annual Sonnenwendefer (midsummer
festival) organized by the freethinkers of Jena. The winter solstice had not caught
on as a secular alternative to Christmas, but the summer festival was very popu-
lar. He had given the speech two years before, when the local social democrats
still had an uncomfortable relationship to a ceremony then too much in communist
hands for their taste. Illness had kept him away in 1930, but now he was set to
rally the troops against church and capital in a ceremony which Das Volk, the local SPD newspaper, presented as a joyful, ecumenical affirmation of the secular faith by the entire working class of the town, but was actually controlled by the social-democratic freethinkers and the SAJ.102 The KPD’s policy of “revolutionary unity” — splitting — had, after all, left the town’s group of proletarian freethinkers more firmly in social-democratic hands than it had been for a long time.

On this Friday afternoon and evening, men and women, boys and girls made their way to the Otto-Schott-Platz, a large clearing in the woods above the city that was used as a sports ground. Children “romped in the fresh forest air”, people ate and drank, and the SAJ showed pictures of their camp: posters describing the development of the freethinking movement provided historical instruction. On the lower part of the square stood the great pile of wood awaiting its festive ignition, and a huge red flag fluttered in the wind. Then, as dusk finally fell, came the announcement over the loudspeaker of the Workers’ Radio League that the ceremony was to begin. The crowd of thousands fell silent.

The songs of the Jena Peoples’ Choir rang out into the mild summer night and cast their spell over the great proletarian congregation. The chorus [Sprechchor] of the workers’ youth showed how humanity still lies in the chains of reaction, how the torch-bearers of the new age light up the darkness, how they burst the chains...

This to the accompaniment of drums, violins and fanfares. Now the diminutive figure on the podium stepped into the limelight:

Solemn silence. No sound disturbed the hour of proletarian celebration. Comrade Schaxel gave the fire speech, which, amplified by loudspeaker, rang far over the great square into the forest.

The talk had gone down pretty well in 1929, so he gave the same one again. This scientist who urged his colleagues to be vigilant against the merest suspicion of vitalism or faith in a higher power, worked to keep his audience spellbound with a speech that declared the scientific certainty of secular salvation. As befitting the occasion, he developed a simple symbolism by blending the dialectics of nature that he had helped to dig out of Engel’s notes in the archive in Moscow with a reminder why he and his audience had come together:

Today height of summer, seasonal development of life in nature reached fullness. In its prime first signs of age: yellow leaves; change to descent in the arc of becoming. Beginning of negation in the dialectical process, which carries its resolution within itself.104

Then he raced through the materialist catechism:

Activity of the living nature that surrounds us bound to seasons. Socialized man ... makes himself independent of seasonal change. He masters nature....

Very many work, only very few harvest.... [C]apitalism and proletariat....
Struggle for existence in nature continues in the class struggles of history — also a dialectical process, of which we are at the same time subject and object. We make our history with sweat and blood.

Now came the punch-line:

As the activity of life in the course of the year so the dialectical process of the history of society carries negation and resolution within itself. Here as there change. One time, time of transition....

The forces of nature, cosmic and terrestrial, power the natural process. The class that can develop, the offensive proletariat, drives the social process forward.

Much as this would have made most of his university colleagues chose on their beer, in this forum it was by now hardly controversial — but then controversy was the last thing the organizers wanted this midsummer night. The American journalist Hubert Renfro Knickerbocker reckoned Jena "literally another world" from "the desolate territory of empty mills and wretchedness just a few hours away". He presented Jena and Zeiss as "the real Germany — the Germany of order and industry, cleanliness and comfort, productiveness and skill", but he had to admit "i was not easy to understand" why nearly 30% of Zeiss workers were communists. Even in Jena, an oasis of comparative well-being where the absolute number of SPD votes would unusually increase the following June, the deep divisions of the years after the war were hiding. The point of the Sommendiener was to show unity.565

First, unity against the threat from the right, which was now ever-present, especially in Thurinagia, where the National Socialist Wilhelm Frick held the powerful post of Minister of the Interior, and Nazi students were organizing in Jena Frick had forced the appointment to a professorship of racist ideologue H. F. K. Götther, foreshadowing the building of Jena under National Socialism into one of the two main university centres of racial hygiene, where the right would also claim Haekel's mantle as their prize.566 On the following nights, encouraged by President Hoover's granting to Germany of a year without repayments, solid bourgeois clubs gathered around midsummer fires, flying the old monarchist flag and vowing to defend the fatherland to the "last drop of blood".565 Second, the socialists' Sommendiener was trying for a few hours to forget the divisions within the Marxist camp. But these were so deep that they could not just be ignored, and Schaxel, who had managed carefully his relationship to the parties of the left, was well placed to reassure his audience that all would be well in spite of the splits. Finally forced to choose, he had remained in leading positions in the freethinkers and the Workers' Radio League, and defended the reformist tactics of their social-democratic leaders rather than joining the small communist breakaway organizations. So these days he did not always get an easy ride from the communist press; half a year later even the "right-wing deviationists" of Thalheimer's KPD (Opposition) would lambast a speech defending the social-democratic freethinkers' leadership. It had been "a top performance of undemanding platitudes in the area of Marxist thought": Schaxel
reckoned the political strike an impossible weapon in such a crisis, so
we should wait for better times (the consolidation of happenings in heaven) till an
attack is possible. The Nazis were only 35% of the voters, apart from which
they were internally hollow, not active and not ready for the struggle. (Ergo: it's
not so bad about the fascist danger after all.) At the end some superficial re-
marks about the cultural reaction.... One true word Schanel did say, which we
would not wish to conceal: Philosophy is opium for the people. Very true! 
Nevertheless, he certainly had much more credibility in communist circles than the
hated SPD hawks. He wound up:

The necessity of the dialectical process drives us on to make our own history!
When the leadership doubts, we remember: individuals don't lead, the masses
move the world! Renewal happens from below. Foom below! The naturalness of
the social process moves it from one transition to the next.

Socialism would succeed capitalism as surely as leaves turn from green to yellow.
At the end he intoned the chant that was the signal to light the fire:
Let the flame rise!
What is rotten sinks into grave and gloom;
We push it as it falls!
We want to build the world anew;
We now are nothing, let us be all!

For the proletariat would dig the capitalists' grave, and the last would be the first
and only ones to be saved. But were organized workers to save themselves, or were
they to be saved by the historical laws of nature and society? Or did his listeners
say the stuff about "dialectical necessity" and "subject and object"? Did they allow
the red priest of nature to stipulate the meaning of their ceremony? Fine words on a
special occasion to be forgotten before work the next morning, a moving night out
that helped to make up for the dullness of work — or the despair of having none —
or, as Paul Loët wanted it, a message of hope that transcended differences of party,
"purifying and making strong for the struggle for socialism, for freedom and
progress"? Perhaps the word did seem to be capitalism, collapsing under the weight
of its contradictions and consumed by the flame of the proletarian fire, "said Schanel
himself, probably when he gave the same speech the following evening in nearby
Eisenberg, reckoned the "shining and consuming fire" a metaphor of the freethink-
ers' own fate: "We shine into the dark of the past with a view of the bright future.
We shall not win it without the stigma of struggle," He but it was the spotlight on
the roof of the Zeiss works that lit the celebrants home.

Two years later the German labour movement was destroyed and Schanel beginning a
difficult decade of exile in the Soviet Union. He was stripped of German citizenship,
his doctorate and membership of the German Zoological and Genetical Societies. Now he claimed to have warred even in the Grundzuge of the disastrous direction in which German biology was heading. We have seen that, in fact, he had come a long way since then. In his autobiography he took issue with those who had denounced his professorship as a "political" appointment of the Weimar Republic, insisting that since it dated from 1916 it had been an act of the Archduke of Saxo-Weimar.

I am not, as some provocateurs have claimed, a "red" professor, someone who profited from the revolution, but (sorry!) an archducal one. For a revolutionary there was nothing to gain from the lost German re-volution. Schael was not appointed a "red" professor, but through his actions and those of others was made one.

The most basic criterion of the seriousness of the alternative Schael offered is its historic success or failure. At first sight, it seems clear that it failed — obviously he did not win the battle for Weimar science, and "dialectical biology" is on few lips today — but this kind of judgement in fact depends acutely on where and when the clock is stopped: in Jena it seemed for decades after 1945 that, in the end, it had won. For the history of Weimar science, the most relevant question is how other Germans rates Schael's chances in the last years of the Republic. And here it is clear that, while the constituency of those who might be considered active supporters was quite small, the number of people who either confidently expected or fearfully anticipated the communist victory, in which if he had played his cards right he could have participated, was large.

A second way of reflecting on Schael's making is to ask, in what sense did he come to be engaged in a radical project? He certainly ended up on the far left of the Weimar professoriate, and his dialectical biology appears radically collectivist. I have focused, however, on the social politics of Schael's practice, especially as a theorist, reformer and populariser of biology. And in terms of Weimar struggles over the production, not just of particular forms of natural knowledge, but of who would produce them, where and for whom, we have seen that his actions were rather more contradictory. From 1924 he argued that not only rigorous science, but also the proletarian, must be protected from "the swining of the cultural fog of the bourgeoisie". This involved a contested attempt to establish the authority of Marxist scientists, including against much more radical challenges to official science than he was interested in mounting himself. His position between university and proletariat in fact made Schael quite restorative with respect to the 'who' of scientific production. And this involved him, for whom 'popularization' was the ostens of his political struggle, in working within a scientist's conventional understanding of that problematic term. But though he claimed the leading role for red professors, workers were to usher in a new scientific era, and labour institutions were the key arena of struggle; with respect to the 'where' and the 'for whom', his actions were radical indeed. They challenge historians to take seriously the rejections and distinctions between the various arenas of early twentieth-century science.
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27. Julius Schanz, Die Leistungen der Zeiten bei der Entwicklung der Metazoen (Jena, 1915), 130; idem, "Mechanismus") (ref. 25), 189-90. In, op. cit. (ref. 2), 1027, agreed with Spemann that Schanz was wrong. Moczk, Jesu (ref. 2), 173, considered Spemann's presentation of the dialectical relationship of determination and regulation superior to Schanz's denial of regulation. My point is that Spemann was able to force Schanz himself to so such conclusion.


29. On Schanz's university career, see Uschmann, op. cit. (ref. 23); on Zeiss, see most recently Rüdiger Stolz and Joachim Wittig (eds), Carl Zeiss and Ernst Abbe: Leben, Werken and Bedeutung (Jena, 1995); on Jesu more generally, see Herbert Koch, Geschichte der Stadt Jena (Stuttgart, 1966); Jürgen John (ed.), Junge naturgeschichtlichen Beiträge (Jena, 1993).


31. Schanz made a few statements in which he insisted that in addition to theoretical reform, biology urgently needed more facts; see, for example, his "Über die Natur der Fortvorgänge in der tierischen Entwicklung", Archiv für Entwicklungsmechanik der Organismen, 1 (1922), 498-525, p. 525. His position was flexible enough that he could emphasize either conceptual clarification or empirical accumulation depending on his immediate purpose and audience.

32. Schanz to Dresen, 29 July 1918, Universitätsbibliothek, Leipzig: Driesch papers.

33. On the "crisis of learning", see Fritz K. Ringer, "The decline of the German mandarin" (Cambridge, Mass., 1989); Feiman, op. cit. (ref. 9).

34. Julius Schanz, Grundzüge der Theoriebildung in der Biologie (Jena, 1939), 1, hereafter GTh; 2nd edn (Jena, 1922), hereafter GTh2.

35. GTh, 13, 18. For Haeckel and his critics, Schanz's attack on him was the most important fact about the Grundzüge, see note to 1 February 1919 in Kradde (ed.), op. cit. (ref. 2), 84-85; Wilhelm Baumstoch to Haeckel, 31 March 1919, EHR: Haeckel papers; W. B. Reinbach, "Karl Wilhelm Kradde", Nova Hiberniae, viii (1919), 23-24.

36. GTh2, 5-7.

37. GTh, 85. Pace Moczk, "Entwicklungsmechanik") (ref. 2), 170. Schanz did not confine himself
to critiques of positions that were unexamined in the specialist literature or textbooks. He certainly spent a good deal of time on these, but his main concern was that the boundaries between "intensive vitalism" and everyday science were being breached routinely.

38. GTR.2, p. iv.

39. Schaudel used Haeckel's metaphor of men being able to see the wood for the trees; see GTR.76; Ernst Haeckel, Die Weite und Tiefe, Gemeinverständliche Studien über monistische Philosophie (Bonn, 1889), p. vi.

40. GTR.65.


42. GTR.214 and n. 224.

43. Fleck, op. cit. ref. 41.

44. GTR, 12-13; GTR.19. Other retrospective iconoclasm, such as disparagement of "iso-electric preferences" and opposition to the threat of science as planned industry destroying every individuality (Eigenschaft), may be found in his "Ernst Haeckel und seine Studente", in Heinrich Schnädel (ed.), Was wir Ernst Haeckel verdanken: Ein Buch der Verehrung und Dankbarkeit (2 vols., Leipzig, 1914), 6, 269-71.


47. Julius Schnädel, "Über die Darstellung allgemeiner Biologie", Abhandlungen zur theoretischen Biologie, i (1919). See also his intervention in the debate over reform of the medical curriculum: Die allgemeine und experimentelle Biologie der Neuerung der medizinischen Studieng (Jena, 1921).

48. Hans Driesch, The science and philosophy of the organism: The Giordano Lectures delivered before the University of Aberdeen in the year 1907 (2 vols., London, 1908), i, 4 and ii, 3. He became full professor of philosophy in Cologne in 1919. Driesch shared Schnädel's interest in university subjects, and the two men became relatively close-politically and socially -in the first years of the Republic, in spite of their earlier polemics (see Schnädel's letters to Driesch, Driesch papers).

49. See, in his Einleitung in die theoretische Biologie (Berlin, 1901), 2nd ed., 1911, the only chapter I know to have put the term "theoretical biology" in a book title before Schnädel's Abhandlungen, but Schnädel did not cite him in the formation of the Grundzüge. For a sketch of Haeckel-opponent René's position that the evolving world was the "dream of a divine intelligence, see Rudolf Eisler, Philosophie-Lehrbuch: Leben, Werke und Lehren der Denker (Berlin, 1912), 371. On the comparative outsider (look for, say Harrington, op. cit. ref. 9).

50. E.g. GTR.31 and 163-4.

51. Karl Sappey, Biologia generalis, ii (1920), 336-41, even reckoned Schnädel securely sympathetic to the "organismic tendency", which Schnädel himslef considered vitalistic. Haeckel had been
tol by Mauser and Heinrich Schmidt that the "brilliantly written" work was "decked out with dualistic metaphysics"; see Krader(14), op. cit. (ref. 22, 85).

52. Diersch was carefully solicited for an early contribution; see Schauel to Diersch, 13 December 1918: Diersch papers. Reinske also wrote an Abhandlung, but Unckel did not.


56. Dottina Jatta Haraway, Crystals, fables, and fields: Metaphors of organization in twentieth-century developmental biology (New Haven, 1978); Abre-Am, op. cit. (ref. 54); and also V. B. Smorodina, "Übersetz biologie: the evolutionary synthesis and evolutionary biology," JHB, xxx (1992), 1–65.


58. GTB, 4: Schauel, "Darstellung" (ref. 47), l.

59. This was, however, probably in Jan 1818, after Schauel had finished the Grundriss. He sent Hilbert, with whom he had been "zweisätzlich" discussed the "uncertainty of biological conceptions," a circular about the Abhandlungen, to which he claimed Hilbert's (inconsistently) wayward student, Hermann Weyl, now in Zürich, had said he would contribute (he did not); see Schauel to Hilbert, 27 December 1918, Niedersächsische Staats- und Universitätsbibliothek, Göttingen; Hilbert papers; and further Schauel to Diersch, 27 December 1918: Diersch papers. On Hilbert and modern mathematics, see Herbert Meijer, Madame Sophie's Mathematician: Eine Geschichte des Streits um die Grundlagen der Disziplin und des Subjekts formaler Systeme (Frankfurt am Main, 1990).

60. Harwood, op. cit. (ref. 5), 28–29.

61. Schauel, "Darstellung" (ref. 47), 36; GTB, 69. Biologists and historians of science have spent
more time discussing their views of Spemann's psyche-Lamarckism and allegedly cryptovitalist tendencies than investigating the more historically relevant question, how contemporaries interpreted his work. Schaefer's quite differentiated criticism is particularly useful because it was published relatively early; he continued to comment on the work of Spemann's school until the end of his life.

62. Schaefer "Darstellung" (ref. 47), f. H. Spemann, "Die Zoologie im medizinischen Studium", Deutsche medizinische Wochenschrift, xvi (1920), 413-5, p. 834. Schaefer noted these "warm words, doubtless spoken 'from the soul'; see Biologie (ref. 47), f. 11. Spemann expressed hostility to "general biology" again in his autography, Forschung und Leben, ed. by Friedrich Wilhelm Spemann (Stuttgart, 1943), 206-9.


64. Harwood, op. cit. (ref. 55) for socialists and pacifists as "outsiders", see e.g. Döring, op. cit. (ref. 63), 8-58.


67. Schaefer claimed he had first joined the SPD before 1914, but had appropriately left in disgust at the party's approval of war credits, so that in 1915 he was re-joining (why not the anti-USDP?), Bei he is reckoned he did nothing before the Revolution; membership began to wane only when it was open. See HHIS: "Autobiographie" 10-11 and 26-27.


69. "Politische Presse", Vorarlberger Zeitung, 25 April 1922, cited by Drogg, op. cit. (ref. 65), 73-75. In June 1922, out of 110 teaching officers, 45 full- and two part-time who were socially Democrats, of whom four were appointed by the Grün ministry, which also quite exceptionally reappointed Karl Korsch as professor; see Schaefer's "Die thüringische Landesuniversität unter dem Ministerium Geiß", Leipzig (Vernissage, xxii), Sonntagnummer "Schwarze in Thüringen", February 1924, 20-21. Korsch was sacked after he had briefly become justice minister in one of three communist to join the government in September


90. Julius Schaefer, "Die Entwicklung der Wissenschaft vom Leben", in the Jahrbuch der Gesellschaft für Psychologie, 1925, 174. (See also Fenchel, Internationale Zeitschrift für Psychologie, 1925, 495.)

91. Peter Höffken, "Die Wissenschaft vom Leben", in the Jahrbuch der Gesellschaft für Psychologie, 1925, 174. (See also Fenchel, Internationale Zeitschrift für Psychologie, 1925, 495.)

92. Peter Höffken, "Die Wissenschaft vom Leben", in the Jahrbuch der Gesellschaft für Psychologie, 1925, 174. (See also Fenchel, Internationale Zeitschrift für Psychologie, 1925, 495.)

93. Peter Höffken, "Die Wissenschaft vom Leben", in the Jahrbuch der Gesellschaft für Psychologie, 1925, 174. (See also Fenchel, Internationale Zeitschrift für Psychologie, 1925, 495.)

94. Peter Höffken, "Die Wissenschaft vom Leben", in the Jahrbuch der Gesellschaft für Psychologie, 1925, 174. (See also Fenchel, Internationale Zeitschrift für Psychologie, 1925, 495.)

95. Peter Höffken, "Die Wissenschaft vom Leben", in the Jahrbuch der Gesellschaft für Psychologie, 1925, 174. (See also Fenchel, Internationale Zeitschrift für Psychologie, 1925, 495.)


99. Hopwood, op. cit. (ref. 17). Schwarte, Eugenik (ref. 14), shows that medical and social policy experts were able to ensure eugenic policies in the social-democratic parliamentary parties of the Reich. By 1914, however, they had developed party conferences and interest groups, which were consequently not considered to be members of the 'middle class'.


101. Eduard Bernstein, Was ist wissenschaftlicher Socialismus möglich? (Berlin, 1901), 32. Also in the Weimar Republic, workers' parties were also able to take advantage of the opportunities for political participation that were available to them.

102. Schumpeter, Entwicklung (ref. 83), 80. Schumpeter's 'archetypal metaphor' is borrowed from the one used by Marx against Bernstein, for which see Meyer, op. cit. (ref. 15), 377.

103. Schumpeter, Entwicklung (ref. 83), 79–80.


105. For "the socials and the states"; see ibid., 2. Writing is a scientific news magazine, Schumpeter denied with reference to the Soviet Union that there was "a communist antimony or binary opposition"; see "Wissenschaft im Dienste der Gesellschaft: Eindrücke aus dem Sowjet-Russland", Die Ordnung, xxv (1926), 147–74. It could consistently deny that the concept of particular sciences was already not in the socialist state. Schwarte, Eugenik (ref. 14), 37, has argued that socialists restricted themselves to critical reception or application of eugenic science because they were generally not engaged in scientific research. Schumpet's case shows that a biology professor could consider critical work the top scientific priority. More generally, even the most productive researcher could make synthetic claims only by reviewing fields in which s/he was not a specialist.

106. Schumel, Entwickelt (ref. 83), 7–8.

107. Kelly, op. cit. (ref. 14), 54. There are some parallels with the British biologist Lancot Hogben's work in the Pheas League, but Schumel instead the experts were needed not so much because their science had the answers as because of the relative, unresolved problems in biology; see
Re, op. cit. (ref. 22), 23-45.

108. Schaud, Entwicklung (op. cit. 83), 26-27; the reference is to Haeckel's defense of Darwinism in "antireligious" against Rudolf Virchow's charge that it was socialistic. On the "vulgar"-materialists, see Fredrick Gregory, Scientific materialism in nineteenth century Germany (Porterfield, 1977).


110. Der neue Rheinland, i (1926), 688.


112. Reviews: Der Naturfreund, xxix-7 (1925), review; Die Naturfreunde, iv (1925), 77; Solinger Volksblatt, quoted in Urmaria, iii (1925), p. 1; Die Augsfelder, "Darwinismus, Lammarskius und Sozialismus"; Urmaria, i (1925-26), 257-9; and Ernst Miilchbach, "Was jeder von der Abstammungslehre wissen sollte", Urmaria, ii (1925-26), 13-15; p. 13; it was also translated into Russian.

113. Richard Goldschmidt, Argen: erste Einführung in die Wissenschaft vom Leben für Jedermann (Leipzig, 1922). Goldschmidt's book was more than three times as long as Schaud's, highly illustrated, and this "pop" edition was probably printed outside most workers' reach.

114. Anatomischer Briefm., i (1923-24), 176.

115. [Rudolf] Wilke, writing in a "literary" library journal. Hecchom, that,"How far the tight jugation of socialism and biological science, in which Schaud believes, actually exists, appeas even in the way his biological exposition basically stands uncorroborated next to the socialist one. He was perplexed by Schaud's combination of "unschwer and internally long overweening scientism" (Skepsiformul) with a "no less unclear relativism" and "sit von verkaufen - antifascismus". See Hefte für Bücherwesen, 8 (1926), 357-5.

116. The left-wing SPD literary intellectual Dr. Karl Schnait examined the book important in spite of its difficulty and less than unaided construction; see Bücherwarte, i (1926), 17.

117. Ludwig Plat, Archiv für Rassen- und Gesellschafts-Biologie, xviii (1926), 223. Schnait had himself written book reviews for the Archiv in its more pluralist days under the Empress.


119. Borden, op. cit. (ref. 92), 11.

120. Julius Schaud, "Paul Kammerer", Urmaria, iii (1926-27), 74-75. Herbert Richter, commenting in the magazine of the Saxony_Naturfreunde after reading what Schaud had written, reckoned that "[a]nyone who had believed till now that science and its teaching was fine, will be taught otherwise by the majority for the revolutionary among scholars, Paul Kammerer", see Der Wanderer, 56 (1927). On Kammerer, see Arthur Kutscher, Case of the midwest toad (London, 1971); Alfred Hirschimiler, "Paul Kammerer and the Vereinigung erworbener Eigenschichten", Medicinischen Journal, xxvi (1991), 26-77.

121. "Paul Kammerers Bedeutung für die Biologie", 7 December 1926, EHHS: "MS von "vertagen, die J. Schaud gehalten wurden."


123. Schnait, Entwicklung (ref. 83), 3.

124. Compare Richard Goldschmidt's view: "Of course there are professional populizers...Not here first-hand information. They usually cannot discern what is important or unimportant, essential or nonessential, certain or questionable. In addition they tend to exaggerate, to be sensational, to promise future developments, to cater to the tastes of the lower class of readers. It is therefore the duty of the man with the first-hand information to disseminate it..." See In and out of the ivory tower: The autobiography of Richard B. Goldschmidt (Seattle, 1960), 69. For more in general demand these scientists should address themselves directly: see Niles
relationship between Heidegger, for whom individuality was a hermeneutic necessity. Schaeff and Heidegger needed further investigation. Sciences which became Marxists in the 1950s not uncommonly discovered a sort of "pre-established harmony" between their previous practice and the new philosophy. J. B. H. Haldane, for example, notoriously produced "testimonials" to the "purest medicine" of a dialectical materialism that bore a striking resemblance to his father's "scientific deism." See Rép, op. cit. (22), 101-5. Since Schaeff claimed deliberately to have been working towards the "dialectical biology" for his entire career, and especially because Heidegger was a major resource not just for him but for Marxists generally, it is likely that in this case the debts were deeper.


153. Schaeff, "Individualism" (ref. 151), 492.

154. For a list of the university courses which Schaeff attended, see Penullin, op. cit. (ref. 2), 1029-32, and on their non-distinction, see: EHSS: "Autobiographie", 29.


156. Schaeff, "Individualism" (ref. 151), 475-6.


159. Schaeff, "Individualism" (ref. 151), 469.

160. For an example of his writing against religion and group back to nature, see Schaeff, Menschen (ref. 145), 42, 46; for the conflictlessness of the socialist culture of science in which Schaeff participated, see further Huppg, op. cit. (ref. 17); and on the general viability of social democratic culture at the end of the Republic, compare Peter Lüthi and Franz Walter, "Zur Organisationskultur der sozialdemokratischen Arbeiterbewegung in der Wöllers-Republic. Niederlagen der Klassenkultur oder soligdemokratischer Höhepunkt?", Geschichts- und Gesellschaft, XV (1989), 51-36, and Hartmann Wunderle, "Nach einmal: Niederlage der Klassenkultur oder soligdemokratischer Höhepunkt?", Geschichte und Gesellschaft, xvii (1992), 88-93.

161. These ceremonies are usually associated with the right, and Guinon, op. cit. (ref. 23), 67-70, described them as a specifically sithic feature of the monet movement. In fact, as the following description will show, left-wing monetists worshipped the sun too. On mutual science
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162. *DV*, 22 June 1929; Neue Zeitung, 22 June 1929.

163. "Sommerwandern," *DV*, 20 June 1931, from which all quotations are either the event are taken; see also *DV*, 19 June 1931: "Johannstag," *DV*, 24 June 1931; and "Jenaer Volkskultur," 20 June 1931.

164. This and the following extracts are from Schurz's i.e., "Sommermonatserinnerungen 1929/31 Jena," EHS, "MS von Vortraggen".

165. *Bl. R. Knöchelicker, The German Crisis* (New York, 1932), 59, 68 (thanks to Jürgen John for drawing this book to my attention), for the election result, see Kleinke, *op. cit.* (ref. 74), 729.


170. EHS, note added to "Sommermonatserinnerungen," *op. cit.* (ref. 144), dated "19/6/31 Jena; 20/6/31 Eisenberg.


172. Just before his mysterious death Schaezle was closely associated with the German communist leadership in exile; see Keale (ed.), *op. cit.* (ref. 2), 123. Had he lived he would probably have occupied a very senior position in the GDR; his exceptional student Greg Schneider was professor of theoretical biology and director of the Ernst-Haeckel-Haus in Jena from 1947 to 1959, see Stelzig (ed.), *op. cit.* (ref. 71), ii, 808; Gabrielle Apte, "Georg Schneider (1900-1970)," in Jena-Informationsblatt, *Jenaer Studentenbund erinnert ...* (Jena, 1983), 73-74; Penzel (ed.), *op. cit.* (ref. 31, 112.