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ABSTRACT This paper applies Bourdieu's theory of the scientific field to examine the sources of authority, reasons for conflict, and group dynamics in an isotope lab at a Chinese university. After 7 months of participant observation and non-structured interviews, I found that theoretical capital and technological capital are both used in the isotope lab. While both are associated with scientific authority, it was theoretical capital that determined lab members' social authority. Dominant and subordinate members of the lab applied different strategies to advance their interests. Conflicts of interest induced competition between the holders of theoretical and technological capital, which in turn caused interpersonal conflict. The specificity of the field of geoscience determines the relative power of technological and theoretical capital, and the low autonomy of the scientific field in China strengthens that hierarchy. I find that this hierarchy of scientific capital in the broader field can have a considerable impact on the social construction of experimental results in the local settings.

Keywords China, field theory, geoscience, technological capital, theoretical capital

Domination in a Scientific Field:

Capital Struggle in a Chinese Isotope Lab

Wei Hong

The science and technology studies (STS) literature over the past three decades has addressed politics in Western scientific settings,[1] but the field has moved so far beyond positivism that some very important theorists such as Bourdieu have been neglected. Bourdieu's discussion on the specificity of the scientific field articulates the relationship between knowledge production and the broader social and political context well and provides a useful framework for STS. This paper revisits Bourdieu's work and uses a case of authority struggles in a Chinese isotope lab to shed new light on the relationship between theoretical and technical expertise, the political strategies deployed in scientific settings, and the specificity of the Chinese scientific community in the field of geoscience.

Bourdieu's theory integrates the concepts of field, habitus, capital, and interest (for an overview, see Bourdieu & Wacquant, 1992). A field denotes a social space in which positions of interest are interrelated, and habitus is enacted in a competition game using different forms of capital. According to Bourdieu (1990: 56), '[t]he *habitus* – embodied history, internalized as a

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second nature and so forgotten as history – is the active presence of the whole past of which it is the product'. Habitus is a 'feel for the game' acquired by game players through a lengthy period of socialization in a field and may be subject to adjustments in light of new experience. Once habitus is unconsciously internalized, a game player's behaviors and reactions in the field become instant and intuitive. No rational calculation is needed. Each field creates and maintains its own set of interests. These interests are self-evident to players in the field, but the interests with which they identify differ in accordance with the positions they occupy. Players' pursuit of interests is not due to careful calculation. Instead, they implicitly recognize the contested goals, and their habitus is critical in constituting both goals and strategies for pursuing them. Habitus possesses high inertia, and so when a field changes, goals and strategies may persist beyond the conditions in which they were formed.

Bourdieu (1986) proposes three forms of capital: economic, cultural, and social. Just as economic capital brings about monetary profits, cultural capital leads to academic and career success. In a scientific field, symbolic capital such as academic credentials and scientific expertise belong to cultural capital. Since multiple competing forms of capital exist in the same scientific field, each participant is likely to try to maximize the scientific value of his or her specific capital. The process of competition yields the forms of capital that are most valued in the specific field. The amount of field-validated capital different participants own determines their scientific authority, and in turn determines their status in the field. In the struggle for scientific authority, a scientist's position within the field determines the strategies used for realizing his or her interest. The dominators adopt *conservation strategies* (Bourdieu, 1975: 29) and hope to continue the current scientific system that is intimately related to their interests. The subordinates face two options: *succession strategies* or *subversion strategies* (Bourdieu, 1975: 30), admitting or challenging the legitimacy of the current dominance. The latter is much riskier but more profitable when successful. Strategies people adopt can affect the distribution of power and capital, thus modifying the structure of the field; they also can initiate strategy adjustments responding to fluctuations.

In this paper, the notions of theoretical capital and technological capital, embodied in theoretical competence and experimental expertise, are introduced as two competing categories of scientific capital. Stephen Barley and his colleagues (Barley, 1986, 1990, 1996; Barley & Bechky, 1994; Barley & Orr, 1997) extensively discuss technicians' roles in the workplace, particularly in scientific settings. Their main argument is that technicians serve as brokers between technology and their clients. However, the contextual knowledge they draw upon to solve technical problems is not appreciated as much as formal knowledge (see also Keefe & Potosky, 1997; Doing, 2004). Thus, whether technological capital is valued less than theoretical capital in specific scientific and technical settings is an important question I address in this paper.

My research was on an isotope lab at Central University (CU), a research university in central China.[2] Participant observation and non-structured interviews were used to gather most of the data. My observations occurred between March and October 1998. I visited the isotope lab two to three times a week, observing the members' working styles, conversations, and other interactions. I asked direct questions to the lab members when less obtrusive observations and interactions left questions unanswered. These data were combined with documents from the lab or from the Internet. The latter source allowed me to track publications of some lab members even after I left the lab.

This paper is organized into five parts. The first part provides background information on China's higher education policy, the environment in which the isotope lab was embedded, and the field of geoscience. This part also introduces the isotope lab, including the historic background, daily operation, and personnel composition of the isotope lab. The second part identifies the scientific and social authority in the isotope lab and describes an interpersonal conflict that I observed. The third part applies Bourdieu's theory to analyze the specificity of the field of geoscience in China and to explain the interpersonal conflict in the isotope lab. The fourth part discusses the relationship between theoretical and technological capital. The final part concludes the paper.

Introducing the Isotope Lab

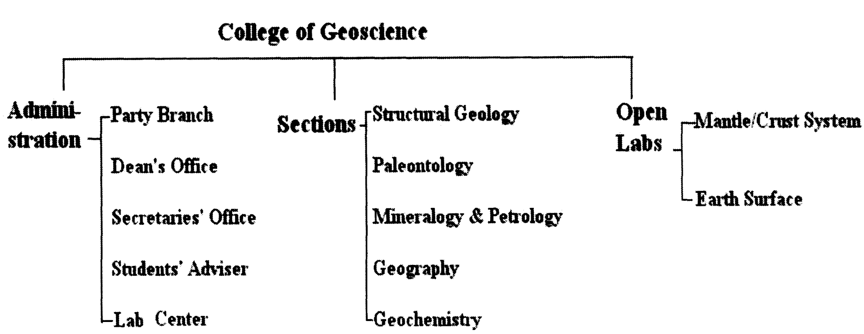
Background Information

Before going into detail on life in the isotope lab, a brief orientation is needed for readers who are unfamiliar with Chinese universities and labs. When the People's Republic of China was founded in 1949, there were 205 universities. Following the Soviet Union pattern, the new government regarded these universities only as settings for higher education. Research was consigned to research institutes overseen by the Chinese Academy of Sciences, local governments, and various industrial ministries (Chinese Education Ministry, 1999). After the long-term disorder and stagnant scientific development caused by the Cultural Revolution, President Deng Xiaoping decided to rebuild universities into centers of education and research, as part of the effort to modernize China. Given the constraint on resources, however, it was impossible to invest equally in every university. Therefore, from 1987 to 1989, 416 concentrations distributed across 107 universities were chosen to have priority in receiving national funds. China also got a loan of US$100 million from the World Bank to support this program. At about the same time, it was discovered that the Soviet Union had been establishing research labs in universities since the 1950s to conduct cutting-edge research and to combine teaching with research. Hence China also began to build national research labs in universities in the 1980s. Seventy per cent of the World Bank loan went to infrastructure development in those national research labs (Chinese Education Ministry, 1999). Though directly managed by the universities where they are located, these national labs are under the jurisdiction of the central ministries. They are open to visiting scholars to promote an efficient use of the facilities. Take CU for example: mineralogy, petrology, and paleontology in the College of Geoscience are among the 416 chosen concentrations. In 1987, a MAT-261 mass spectrometer worth RMB1.44 million (approximately US$180,000) was purchased and an experienced engineer was recruited to build the isotope lab, using the World Bank loan money. In 1994, an open lab was founded specializing in the mantel/crust system (abbreviated as the MCS Open Lab). Although it was not a national lab, it was under the jurisdiction of the Ministry of Geology and Mineral Resources, and was built in a similar context.

Figure 1, from the webpage of the College of Geoscience at CU, shows the structure of the college. The 'Party Branch' is an omnipresent agency in Chinese work units, possessing the highest administrative power (Walder, 1986). The 'Sections' are five teaching concentrations into which faculty members with similar interests are clustered. Although many faculty members are now involved with both teaching and research, a teaching group from the older university tradition is maintained. The MCS Open Lab is a research team studying the composition, kinetics, and evolution of the continental crust. Projects in this lab are multidisciplinary in nature, involving petrology, mineralogy, and geochemistry. Since its establishment in 1994, the MCS Open Lab has obtained more than 100 grants and published more than 500 papers, including 30 in international journals. The MCS Open Lab is relevant to this paper because the isotope lab, previously subordinate to the Lab Center, was put under the control of the MCS Open Lab in 1994.

Geoscience is a broad research field including many disciplines, including mineralogy, petrology, geoarchaeology, geochemistry, and others. The research subjects are mostly related to the Earth, from rocks at the surface to minerals in deep strata; from fossils from ancient times to just-ejected volcanic rocks; from the ocean floors to the continental crust. Because of these features, experimentation and fieldwork are extremely important for theory development. To test a theory, geoscientists search for the right samples through fieldwork and perform experiments on them. A recent paper published in a prestigious journal illustrates these relationships well. The argument was backed up by chronological analysis, mineral analysis, major and

FIGURE 1
The structure of the College of Geoscience



trace element analysis, and isotopic analysis of rock samples found in North China. The experiments were conducted by scientists in Beijing, Xi'an, and the isotope lab in CU. Guan, the first author, was the director of the MCS Open Lab and the Xi'an lab. The remaining credits were shared by two scientists in Xi'an, three scientists in CU including the head of the isotope lab, two scientists in Jilin where the samples were found, and two overseas scholars. Thus, we can see that co-authorship was given to researchers who provided fieldwork and experimental support, but that those doing theory testing and development also were key actors.

Pinxian Wang, a famous geologist and fellow of the Chinese Academy of Sciences, has criticized Chinese geoscientists for being too passive in international collaborations. They provide overseas scholars with raw data collected in China, without being aware of the research questions involved in their collaborative studies. Therefore they cannot make significant contributions (Wang, 2006). The paper shows us that some exceptional Chinese geoscientists have made a move from data providers to critical thinkers. However, after being given only 20 years of catch up, the Chinese geoscience community has not overcome its peripheral status in the international community.[3] Thus, we should understand the authority struggles in the lab in the context of its peripheral status in the larger field of geoscience.

The Development of the Isotope Lab

The isotope lab was founded in the Lab Center of CU in 1987 with the loan from the World Bank mentioned earlier. When I made my observations, the lab used isotope analysis of rock samples to develop chronological measurements, isotopic compositions, and measurements of element concentrations in rock samples for CU and other geology institutes. The service fees provided part of the income for the Lab Center, to which the isotope lab was subordinate before 1996.

In 1994, CU finished constructing the MCS Open Lab, during an effort to build labs to promote advanced research in universities. The isotope lab and the MCS Open Lab were founded in order to create a better environment for the development of the chosen concentrations, but conflicts occurred between them regardless of that goal. The initial MCS Open Lab might not be called 'a lab' because it did not necessarily include any laboratory facilities. Since the isotope lab's work was intimately related to the research in the MCS Open Lab, MCS Open Lab applied for proprietorship over the isotope lab. By so doing, the MCS Open Lab could save a large amount of expense on sample testing. Although the Lab Center strongly opposed this action, in 1996 CU incorporated the isotope lab into the MCS Open Lab.[4] Thereafter the isotope lab was downgraded to a group, and the position of lab director was canceled.

At the time I made my observations, the new isotope lab had four members, Wu, Lian, Shen, who were men, and Zhu, a young woman who had previously been an assistant lecturer. Wu, Lian, and Shen had been employed from the very beginning, and Zhu joined later. Wu had a BSc in engineering when he was recruited by CU from the Yiyang Isotope Institute. He was appointed as lab director due to his extensive experience in isotope analysis, but when the lab was downgraded to a group, Lian rather than Wu was nominated as the group head. At that time, Lian had an MSc and had just graduated from the College of Geoscience at CU, while Shen had a BSc in chemistry. Later, both Lian and Shen pursued part-time study for higher degrees.

In a relatively stable field with consensus on the preferred form of capital, members are expected to respect the legitimacy of that form. In a newly founded field, or a field in transition, where several competing forms of capital coexist, the currently dominant form is more readily challenged (Bourdieu & Wacquant, 1992). This generalization applied to the isotope lab when it shifted from a technical to a research setting. At the macro-level, the field of geoscience was only slightly disturbed, and no major changes occurred, but the members of the isotope lab at the micro-level faced an unstable field and were expected to engage in a new round of strategic behaviors to establish their own scientific capital as authoritative. The collective emphasis on accumulating different kinds of capital greatly influenced the dynamics and structuring of the small group. I use this case to illustrate the strategic uses of capital in a scientific field.

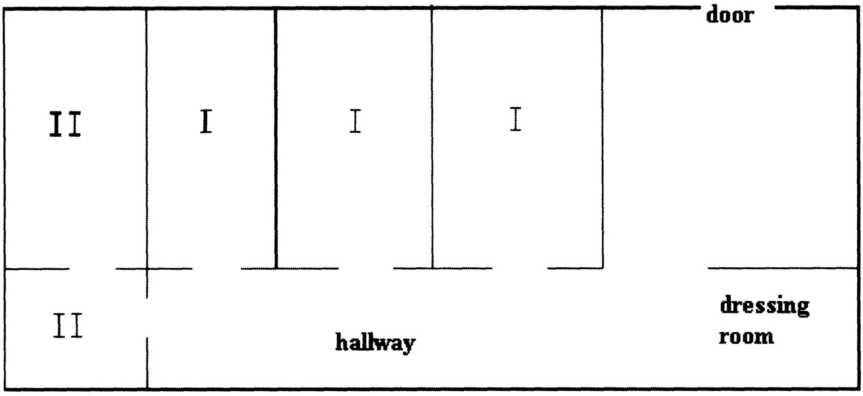
The Status of the Isotope Lab in the MCS Open Lab

The isotope lab and the POEMS II Lab[5] were both subordinate to the MCS Open Lab, which was overseen by the academic committee. The academic committee was composed of renowned experts from various universities, academic institutes, and enterprises. Although they only met one or two times a year at CU, they decided the goals and research orientation of the MCS Open Lab, commented on the projects proposed by visiting scholars, and decided whether or not to fund them. They were the academic authority of the MCS Open Lab. This mode of management was implemented in other open labs as well. Guan and Qiu were the director and associate director of the MCS Open Lab as well as the administrators of the isotope lab and the POEMS II Lab. They were both seen as excellent researchers, and most projects in the MCS Open Lab were under their names.

Daily Operation

The isotope lab was composed of the isotope mass spectrometry lab and the clean chemistry lab. Its routine work was to perform isotope mass spectrographic analysis of rock samples. When the isotope lab received samples from the MCS Open Lab or other geology institutes, the samples would first be chemically separated very carefully in the clean chemistry lab and then prepared in the isotope mass spectrometry lab. Finally the samples would be analyzed with the MAT-261 mass spectrometer. As noted earlier, the experimental results were essential for geoscientists. The clients were usually geoscientists from CU or other institutes who did not own a mass

FIGURE 2
The Clean Chemistry Lab

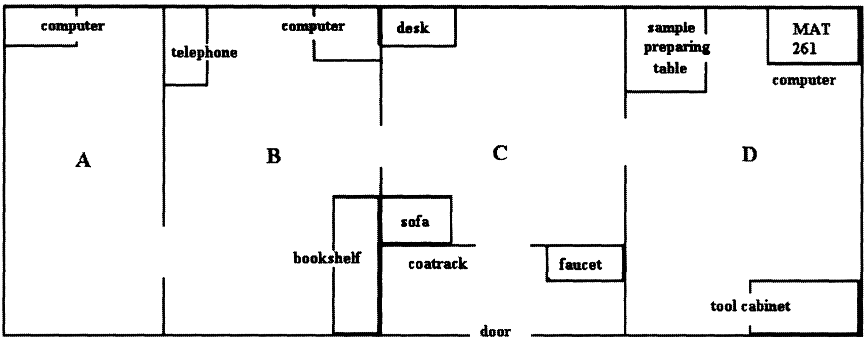


spectrometer. After the isotope lab was incorporated into the MCS Open Lab, the geoscientists from the latter had priority for its services.

Many isotope elements could be analyzed with the mass spectrometer. They could be chemically separated with two chemical methods (method I and method II), depending on their properties. Wu was responsible for analyzing samples separated with method I. The three 'I' rooms in the clean chemistry lab, as indicated in Figure 2, were Wu's territory. Wu could independently complete the whole measuring process from chemical separation, to sample preparation to mass spectrographic analysis. Lian, Shen, and Zhu cooperated to complete the analysis of samples separated with method II. Shen was responsible for the chemical separation of samples with method II, using the two 'II' rooms of the clean chemistry lab. Then Zhu prepared the samples for analysis and Lian completed the mass spectrographic analysis. No matter what chemical method was applied, Zhu typed all reports.

The mass spectrometer needs to be adjusted to analyze specific samples separated with different chemical methods. Because the adjustment process involves a series of troublesome inspection procedures, a standard method is to set an alternating period for different samples. Consequently, when the mass spectrometer is working with one batch of samples that are separated with one of the two chemical methods, the members using the other method can take a break. The alternating period is generally determined by the amount of material in the different samples, but some other factors are often taken into account. In the isotope lab, for example, Lian had a large amount of geoscience research to complete, which could take a month or longer in the field, and so the mass spectrometer was arranged to meet his timetable. When I visited the isotope lab, they were measuring samples separated with method I. Wu was always available, while Zhu and Shen were on a flexible schedule. Lian was in the field with the geoscience project. After he came back, Wu hurriedly finished his own work and the mass spectrometer began to work on samples separated with method II (see below).

FIGURE 3
The Isotope Mass Spectrometry Lab



Because the clean chemistry lab was filled with smelly chemical products, people preferred to stay in the isotope mass spectrometry lab, which was on a different floor from the clean chemistry lab. Figure 3 shows the layout of the isotope mass spectrometry lab.

Room A was Lian's office. It was a comfortable room with a computer, telephone extension, electric heater, electric fan, and books. It was the only private office, which indicated Lian's privilege as the group head. Room B was a public office. The group members usually typed their papers and reports or surfed the internet with the public computer in room B. Room C was a reception room, in which the group members could talk with people who sent samples for analysis. They also utilized room C as a place for rest. They could sit on the sofa, have some tea, or talk to colleagues. Room D was the central part of the lab. All work related to mass spectrography was done in room D. When method I was used for separating samples, Wu spent most of his time in room D. Shen and Zhu were often in room B, using the computer. When method II was in use, Lian and Zhu conducted their experiments in room D. Shen worked in the clean chemistry lab or stayed in room B when the work was completed. Wu relaxed in room C.

In his study of a Berber house in Algeria, Bourdieu (1973) found that the manner in which space is allocated within the house reflects and perpetuates the domination of men over women, suggesting a useful way to read social relationships by observing architectures. One feature of the isotope mass spectrometry lab was that it did not have a central hallway. As the result, Lian had to be given access to rooms B, C, and D, which gave the lab members working in those rooms less autonomy. But Lian's room did not allow other lab members' entry, indicating his privilege as the group head. An interesting contrast is that there was a hallway in the clean chemistry lab, facilitating the equal status of Wu and Shen.

Roles

Table 1 summarizes the four group members' job-related characteristics. Seniority is determined by the number of years they have worked on isotope

TABLE 1
Characteristics of group members

Name	Sex	Age	Seniority (years)	Certificate	Work content	Difficulty coefficient
Lian	M	35	11	No	Sample analysis	C
Wu	M	57	16	Yes	Chemical separation, preparation and analysis of samples	D
Shen	M	33	11	No	Chemical separation of samples	B
Zhu	F	28	1	No	Sample preparation, typing	A

M, male; F, female

mass spectrographic analysis. The difficulty coefficients of their jobs are evaluated based on the knowledge (both formal and contextual) involved, time consumed, and the comments from the group members themselves.[6] It is not a precise measuring system. It is just a ranked scale to describe the skill complexity of everyone's work.

Lian was the formal group leader, responsible for lab administration and the mass spectrographic analysis of samples separated with method II. He also spent much time on research work, which was not a routine job in the isotope lab, but other group members' schedules were arranged to make his research work progress smoothly.

Wu was the oldest person in the lab. In the context of Chinese society, his age alone should have made him highly respected. Besides, he was an expert in mass spectrographic analysis. Although mass spectrographic analysis seems to be a simple procedure, it requires long experience to get an accurate result. For example, the isotope sample in the mass spectrometer is first vaporized and then ionized. If the temperature of the sample is maintained within a certain range during this treatment, the results are accurate. However, the temperature of the isotope sample depends on the temperature of the rhenium filament that carries the sample. Because there is a strong correlation between the electric current applied to the rhenium filament and its temperature, the spectrographic analysis should be easy when those filaments are incised in a standard way. But in actual experiments, most rhenium filaments are not standard.[7] In that situation, experience and intuition become very important for controlling temperature. That is why different results can be obtained by different experimenters even with identical samples. Because of his skill at controlling the temperature, Wu was regarded as more expert than the others. His skills were tacit, in that they could not be fully explicated (Polanyi, 1958; Collins, 1992 [1985]; Barley & Bechky, 1994; Barley, 1996). In an extreme case, an inability to share tacit knowledge caused a 20-year delay in replicating an experimental result (Collins, 2001). Bourdieu also has written on tacit knowledge, essentially describing it as one dimension of habitus 'which exists in a practical state in an agent's practice and not in their consciousness or rather in their discourse' (Bourdieu, 1977: 27). Besides possessing tacit knowledge, Wu was the only lab member who obtained the certificate of the National Measuring Authenticating System (see below). He was an indispensable member who bore half the job.

Shen specialized in chemical separation of samples with method II. His job was relatively easy compared with mass spectrographic analysis. Because Lian also knew how to separate the samples with method II, but Shen did not know how to operate the mass spectrometer, Shen was considered a less essential member of the group.

Zhu was a novice in the lab, and had much to learn from everybody. Lian was planning to visit France for 6 months, and he was coaching Zhu in the hope that she would learn how to do spectrographic analysis independently before he left. Zhu also performed the lowest status jobs in the lab, such as typing, boiling water, and cleaning. Since there were no other novices in the isotope lab, I could not judge whether Zhu's role was due to her lack of seniority or her gender, but according to Wu, the previous female staff members in the isotope lab were not skilled, 'In fact they could not do anything for me. I did all of the jobs by myself and let them sit and chat with me.'

Authority and Conflict in the Isotope Lab

Authority

Lian was the nominal head of the lab, which meant he had the administrative/social authority. He had far more autonomy in deciding his work schedule, and could decide when to take leave for fieldwork or a visit, while the other group members had to adjust their schedules and pace to meet his needs. One day, Lian was analyzing a batch of samples and Zhu was preparing another batch of samples. At 11 am Zhu wanted to leave.

Zhu: I have something else to do. I've got to go.

Lian: You can't. You should finish preparing the samples, or they will easily be contaminated.

Zhu reluctantly stayed to finish the job. She tried again to leave after the job was done.

Lian: Could you weld the rhenium filament[8] before leaving?

Zhu: This can be done in the afternoon. I've really got to go.

Lian: I hoped all these samples could be finished within one week.

Zhu: Why are you in such a rush?

Lian: You know, there are other things to do besides these samples.

Zhu had to give up.[9] Lian's social authority enabled him to control not only junior researchers, but also his senior colleague. One time when Lian had just come back from a field exploration, he asked Wu, 'How many samples are left? When can you finish?' Wu replied that he still needed about 1 week. Lian was dissatisfied and urged Wu: 'Be quick! We've wasted so much time on waiting.'[10]

When Lian was absent, everybody in the lab could work at a pace they felt comfortable with. Once Lian came back, the other group members lost control over their daily work. In contrast to Lian's social authority originating from his formal position as group head, Wu's authority was mainly based on his seniority and expertise in the specific technical area. Wu was proficient with every procedure of sample analysis, and he was especially good at mass spectrographic analysis, the most difficult part of the whole experiment. It was not strange that Wu had technical authority in the isotope lab – his skill was difficult to acquire and was inaccessible to those without his extensive experience. And as mentioned earlier, Wu's age alone constituted another basis of his authority.

Wu's technological expertise was embodied in two objective aspects. First, he passed the qualifying exam given by the National Measuring Authenticating System, and hence had obtained the certificate. This certificate presents an official recognition. If there is any dispute between two labs about one experimental result, the certificate holder can serve as an arbitrator by giving the sample a third test. Second, Wu was able to control the error of his results within 0.03%, even lower than the international standard of 0.06%. This specialized expertise brought Wu prestige and ensured his technical authority in the group. Because of this authority, when there was an ambiguous technological situation in the lab, his proposed solution was respected for being correct.

One day around noon, Lian and Zhu were preparing to analyze some samples. Lian found that the mass spectrometer did not work well and expressed doubt about Zhu's operation.

Lian: Have you added liquefied nitrogen into the vacuum pump?

Zhu: Yes. I did that this morning.

Lian: But it seems that there isn't enough.

Zhu: Really? I'm sure the amount I added is enough.

Lian: So why isn't the machine working well?

Zhu: You can ask Wu. He saw me do it.

Then Lian stopped questioning and the experiment continued.[11] In this example, Lian found that the machine did not work very well and he attributed it to Zhu's mistakes. Although Zhu argued that she had correctly followed the procedure, Lian did not believe her. This was an ambiguous circumstance, as Lian could not conclude that Zhu was absolutely wrong because it was impossible for him to examine the amount of liquefied nitrogen. Some of it had gasified because it had already been poured into the pump several hours earlier. Zhu could not prove that she was right because she was a beginner and she could not give another reason why the machine worked poorly. If she had not cited Wu as a witness, Lian might have stopped the experiment and required Zhu to add the liquefied nitrogen again. But, after Zhu said that Wu had watched her add the liquefied nitrogen, Lian stopped doubting Zhu and continued the experiment to see if there were any other problems. In this case, Zhu would not have persuaded Lian had she cited Shen as the authority, because Shen would not have been expected to have the tacit knowledge (he specialized in chemical separation). The difficulty of this operation lies in the fact that, when poured into the pump, some nitrogen gasifies instantly and produces a white fog that makes it difficult to see how much has been poured. In that situation, Wu's long-term experience was very important for judging if enough nitrogen had been added. This case indicates that both Zhu and even Lian acknowledged Wu's technical authority.

Conflict

Lian and Wu both had authority in the lab, but Wu's technical authority was vulnerable to Lian's social authority, which set up potential conflicts over which form of authority would have priority in a given circumstance.

It was easy to notice the conflict between Lian and Wu. Their conversations were often curt and unfriendly. Lian often talked to Wu with an imperative tone, which implied that he had authority over Wu. The worst conflicts occurred when one did not respond to the other's inquiries, or responded after a conspicuous interval. Occasionally, they even avoided direct conversation.

One day Lian impatiently urged Wu to complete his experiment quickly. Wu kept silent to show his resistance. After a while, someone called Wu for his sample result. Wu told that person the result was not available yet and complained loudly: 'I am already very quick. I don't have time for lunch these days. I didn't even have a rest on Sunday.' Everybody in the lab could hear what Wu said. Obviously, Wu was showing his discontent directly.[12]

Because scientific work involves a high level of uncertainty, bureaucratic control is usually inappropriate and ineffective in scientific and technical settings (Burns & Stalker, 1961; Owen-Smith, 2001). Lian's attempt to exert bureaucratic control over Wu increased the hostility between them.

Their conversations with others also revealed that they did not like each other. When Zhu once caught a cold and coughed heavily, Lian said: 'Oh, what's the problem? You keep coughing, just like Wu. I can't stand that.'[13] (Wu had bronchitis and often coughed.) And Wu also at one time mocked Lian for wearing women's socks when Wu was chatting with Zhu and a staff person in the POEMS II Lab.[14]

When I talked with them, they did not like to acknowledge their opponent's capability. When I asked Lian how he learned to operate the mass spectrometer, he said that when the machine had just been purchased from abroad, nobody in the lab knew how to operate it. They had to study the manual to learn how to operate it. In addition, they visited other institutes to consult with experts who had used that machine for some time.[15]

However, Wu had told me that he had been using the same brand of mass spectrometer when he was in the Yiyang Isotope Institute. That was the reason why CU wanted him. Also, it was he who was responsible for checking on the mass spectrometer after the purchase was made.[16] Their contrasting narratives reveal Lian's reluctance to credit Wu's authority in technical work and Wu's insistence that he had such expertise.

Wu once showed his dissatisfaction with Lian to me:

> Lian was so generous that he gave our cart to others [said sarcastically]. I went downtown[17] to buy the cart and a lot of other tools and waited for four hours to carry them back in the school's bus when the lab was founded. I told him that the cart was essential, and we needed to use it frequently. Then he had to get it back. Another time, he went to a special metal machining factory in Baoji[18] to buy the incised rhenium filament. But he didn't submit clear requirements about the standard and the size of the products. So the factory gave him unsuitable ones. We couldn't use that garbage at all. I went there to argue with them. You know, although we didn't give them a clear description about the size, we specified that they were to be used for mass spectrographic analysis. They should have known what we wanted. At last, their director agreed to reprocess them.[19]

In this case, Wu wanted to prove that Lian was not a qualified administrator. He did not know which tools were essential to the lab and he was not familiar with the conventions for getting the experimental materials. On the contrary, Wu always knew what the proper procedure was. In the above stories, he compensated for Lian's mistakes so that the lab could thus run normally. All these observations indicate that social authority based on bureaucratic appointment and scientific authority based on technological expertise did not easily mesh in the isotope lab. Given that the social authority figure was not as good as the scientific authority figure at the relevant experimental work and that he was younger, his style of managing the lab was constantly challenged by Wu's technical authority.

The Isotope Lab in the Field of Geoscience

The Field of Geoscience in China

Like other scientific fields, geoscience is a Bourdieuian field in which scientific authority becomes the core form of contested capital. One important component of scientific authority is a good publication record, which implies recognition from colleagues. From the paper mentioned earlier that was published in the prestigious journal, we learn that a top-quality paper in this field is based on novel samples, good experimental work, and a sound theory. Therefore, the chase for scientific authority in the geoscience field entails the accumulation and integration of both theoretical competence and technological skills – theoretical and technological capital. Although these are broad concepts applicable to many disciplines, they have specific expression in the field of geoscience. Technological capital is mainly embodied in locating unique samples and getting accurate experimental results.

Theoretical capital is the capability to construct experimental results as recognized scientific facts. Different weights are assigned to different forms of capital. Although Lian was listed as a co-author of the paper, none of his colleagues in the isotope lab got any credit. Neither did the experimenters in Beijing who completed the chronological and mineral analysis. This suggests that technological capital is held to be inferior to theoretical capital in the field of geoscience. Wang's criticism (2006) about Chinese geoscientists being peripheral data providers further supports this point.

A scientific field in China is usually less autonomous from the state than in Western countries (Morin, 1993). The Chinese government has been designing guidelines for scientific development since the 1950s to ensure that science serves the national economy. Areas deemed to be important for economic development are given more funding and attention. However, many research grants, especially the larger ones, are decided by administrators lacking scientific expertise (Wu, 2004). A paper recently appeared in *Science* describing the new 15-year science and technology plan in China as 'a multibillion-dollar gamble'. This plan incurred criticism from several distinguished overseas scholars of Chinese origin (Hao & Gong, 2006). As previously discussed, scientific authority has both scientific and social dimensions. In China, the correlation between these two dimensions is relatively low. Although scientific authority does bring social authority along with it, social authority is not necessarily based on scientific competence and does not even need to justify its domination with scientific reasons.

Given the above descriptions, the field of geoscience in China may have some specific features that are not universally present. First, unlike in many other fields, in geoscience technological capital is not as important as theoretical capital. Second, administrators who do not necessarily have much scientific expertise decide important scientific matters, from designing scientific blueprints to allocating research funding. To facilitate their decision-making process, administrators may need to articulate or even institutionalize the subtle hierarchy of theoretical over technological capital.

If we treat institutions as game players in the field, the Yiyang Isotope Institute is a player primarily possessing technological capital. It was founded in 1959 as one of the three earliest isotope labs in China. In 1991, it also became an open lab under the jurisdiction of the Ministry of Geology and Mineral Resources. With the most advanced equipment and the most complete methods, the Yiyang Isotope Institute was the only professional isotope lab authenticated by the National Measuring Authenticating System in 1997. The Yiyang Isotope Institute possesses a large amount of technological capital because it specializes in providing experimental services, and most research conducted in the lab is in experimental areas such as isotope chronology, isotope geochemistry, and experimental methodology. Since 1972, the Yiyang Isotope Institute has published 157 papers and received 49 grants, though both numbers are much lower than those in the MCS Open Lab, its latecoming counterpart which is similar in status and scale. The MCS Open Lab could be seen as an institutional player primarily owning theoretical capital. At the very beginning, the MCS Open Lab was built as a part of the plan to enhance the research level in the concentrations of mineralogy and petrology. Scientists in this lab were committed to solving theoretical problems, and some of them had publications in top journals. Although the MCS Open Lab also possessed technological capital, largely because it included the isotope lab, none of the research conducted in the MCS Open Lab was related to isotope experimental methodology. Therefore, that lab's technological capital was subordinate to theoretical research. The volume of technological capital in the MCS Open Lab was negligible compared with that in the Yiyang Isotope Institute. The comparison between these two institutional players suggests that funding and publications in the field of geoscience, prime symbols of scientific recognition, are mainly allocated to players who mainly possess theoretical capital.

This privileging of theoretical capital could be clearly seen in micro-level settings, such as CU, the MCS Open Lab, and the isotope lab. In CU, the staff members in the Lab Center, a department that dealt with technical work including experimental demonstrations given to students and sample analyses for scientists, did not receive the same treatment as faculty members and researchers in the university. In Figure 1, the Lab Center was neither a teaching nor a research unit. Rather, it was like a unit providing logistic support, along with secretaries and students' advisors. Wu recalled his discomfort when he transferred from the Yiyang Isotope Institute to the Lab Center: 'The university doesn't attach importance to the technical staff. They mainly focus on teaching and research. We are in an inferior status and get lower benefits than faculty members and administrative staff members.'[20] The Yiyang Isotope Institute was an independent working unit where people were preoccupied with experimental work. The nature of the work meant that technological capital was more appreciated than in the broader field of geoscience. The Yiyang Isotope Institute can be seen as a sub-field where the broader field's hierarchy of capital was disguised and technological capital was treated as the most valid form of capital. That was why, prior to his relocation, Wu did not sense the inferior status of technological capital. The Lab Center, though less independent than the Yiyang Isotope Institute, still insulated its staff members from outside competition to some extent. Wu thus could lead the isotope lab for 9 years before being exposed to competition in the larger world of geoscience.

The Isotope Lab as a Unit in the Broader Field

The CU, the MCS Open Lab, and the isotope lab can be seen as places where the struggle in the broader field plays out. In this paper, the isotope lab is the unit of observation. The friction between Lian and Wu can be better understood by locating their positions in the broader field. In the field of geoscience, the amount of technological capital a researcher possesses can be evaluated by his or her accuracy, proficiency, and years of experience with experimental work, as well as by reference to credentials such as technical certificates and publications in experiment-related journals.[21] Given that Wu dealt with the most difficult jobs, possessed the National

Measuring Authenticator Certificate, and worked the longest time on isotope analysis, he had a large amount of technological capital in the field. He also was one of the four senior engineers in the Lab Center. This superior status legitimized his authority in both the social and scientific dimensions in the isotope lab before the proprietorship was transferred in 1996. Wu depicted the authority he had possessed as follows:

> I am the only person here who passed the exam and got the certificate. So, according to the rules, I am the only one who is eligible to adjust the mass spectrometer. And every report we provide must be signed by me. I typed the reports by myself then. Those reports were all consistent with the criterion of the National Measuring System. They should be signed by the director of the Lab Center and me and have the stamp of the National Measuring System. This stamp is a guarantee. If the data we provide were not accurate, the clients could sue us.[22]

After the isotope lab became one part of the MCS Open Lab, it was no longer an independent lab providing measurement services for scientists, but an attached subgroup of a research team. The rules changed a lot.

> **Wu:** Guan prescribed that all reports be typed by Zhu, thus the format would be unified. The format they apply now is not in accordance with standards at all. It's a degeneracy. As the only authenticator in this lab, I should be responsible for our experimental results. But they have taken away that power, now I have no right to interfere with them. They do what they want. Only their conscience could constrain them [from giving out poorly presented results].[23]

As previously described, the MCS Open Lab was a setting where technological capital was subordinate to theoretical capital. It was a place where the logic of the broader field of geoscience was reproduced. Table 2 shows that Lian was the most active researcher in the isotope lab according to the number of projects in which he was involved and the number of articles he had published. Theoretical capital is often reflected in publications and funding, but their specific content determines if they count as theoretical or technological capital. Because Lian's research focused on the early crustal evolution of the Yangtze craton[24] in eastern China, a theoretical project, his publications and funding were regarded as theoretical capital. In contrast, Shen's publications were about the application of isotope analysis for studies of the isotope composition of underground water in a northern province, and the application of the isotope mass spectrometer in geochronology and isotope analysis. The research for these publications all involved applications of the isotope methodology, without any theoretical problems being raised or solved. Shen's publications were thus regarded as technological capital. It can be safely concluded that Lian possessed a large amount of theoretical capital in the field compared with other lab members. Zhu, as a novice, owned little scientific capital, of either the technological or theoretical kind. Zhu admired Lian very much: 'He is young and capable in research. I am his follower.'[25] When I asked Guan why Lian was nominated as the head, he answered, 'We had a meeting to discuss

TABLE 2
Academic background of group members

Name	Education	Title	Speciality	Projects (n)	Papers (n)
Wu	BSc	Senior engineer	Isotope mass spectra	0	0
Lian	PhD	Lecturer	Geochemistry of isotopes	2	11
Shen	MSc	Engineer	Geochemistry of stable isotopes	0	4
Zhu	BSc	Assistant lecturer	Geochemistry	0	0

and decide. In our lab, ability is more important than seniority.'[26] There were about 13 people in the MCS Open Lab. Guan's reply implied three points. First, seniority, traditionally valued by Confucian culture as the base of authority, was trumped by ability.[27] Second, the 'ability' here was theoretical rather than technological ability. Third, the rule was endorsed by the members of the MCS Open Lab. Therefore, neither Wu's seniority nor his technical competence would be appreciated by the MCS Open Lab. Theoretical capital had superseded technological capital, and even seniority could not reverse the hierarchy.

During the transformation of the isotope lab, no one suddenly gained or lost any capital. But the weight of each member's capital changed considerably. Technological capital depreciated and theoretical capital increased in value. This transformation totally reversed the hierarchy of capital and redistributed power among the lab members. Because the change was imposed, the legitimacy of the ascendant form of capital was not accepted instantly, hence, the conflict between the former and the current holder of the most valued form. Because of the inertia in habitus, members of the lab, especially Wu, were slow to accept the changing nature of the field when it relocated.

Despite the ascendancy of theoretical capital, the major job of the isotope lab was still technical work. The necessity to consult on technical problems made technological capital an important source of prestige and informal status (Blau, 1955). Consequently, technological capital remained important, despite being secondary, and the coexistence of the two forms of capital produced competition and conflict in the isotope lab.

Habitus, Interest, and Strategy

Habitus is shaped by games but reflected in game players' behavior. For the members of the isotope lab, their habitus had been under construction since they entered the field of geoscience. Due to different experiences in the past and during the transition in proprietorship, their habitus adjusted differently. One important component of habitus is to have an instinctive recognition of one's place in the field, and to devise appropriate tactics to pursue one's interests. By observing the group members' behavior, including speech, working style, and even dress, we can discern their habitus, including the interests they identified with and the strategies they applied.

Some group members had trouble with adjusting their habitus after the transition, but Lian did not. His PhD advisor was the former director of the MCS Open Lab and the current fellow of the academic committee. His academic training had prepared him to concentrate on theoretical research and minor in experimental work. If he had an adaptation problem, it would be his maladjustment in the previous isotope lab in which technological capital dominated. After the transformation, the objective condition he encountered was similar to the circumstance that produced his habitus. Thus he adapted to the new regime easily. Lian never hid his disdain for experimental work and tried to avoid doing such work by training Zhu as his successor. He came to the lab irregularly and spent most of the time in his office doing his own work. When confronted by Wu, who kept emphasizing his own technical expertise, Lian struck back rudely and made unreasonable demands, perhaps out of sensitivity to potential threats to his status. As the newly nominated head, Lian also distanced himself from other group members by keeping to himself, speaking imperatively, and dressing in a formal suit.

Wu acquired his habitus, in part by cultivating tacit knowledge on mass spectrographic analysis in the sub-field of the Yiyang Isotope Institute, and he sustained it while working in the Lab Center. These two institutions supported his belief in the importance of technological capital. Wu appreciated the work style of the Yiyang Isotope Institute, which he took as his reference point. When he transferred from the Yiyang Isotope Institute to the Lab Center in CU, he found many differences that he could not get used to. At one time Wu asked a client to consult a female researcher in the Yiyang Isotope Institute to select the sample[28] for him, because Wu believed that she was more responsible and reliable than her counterpart in CU. It had taken Wu so long to acclimate himself to the rules in the Lab Center, a technical setting similar to but less autonomous than the Yiyang Isotope Institute. It is not surprising that it would take him much longer to adapt to the rules in the new isotope lab. As indicated by his complaints about the change in his authority, he was dissatisfied, and he seized every chance to tease Lian about his incompetence in technical work. Although Wu was more than 20 years older than the others, he had a sense of humor and liked joking around. He always wore a casual shirt and looked friendly. In contrast to Lian, who openly blamed Wu for being slow or annoying, Wu managed to criticize Lian in a low-key way. It appeared to others that he was just telling a funny story in which Lian happened to do something stupid.

One important aspect of the scientific field is recognition from peers (Merton, 1973; Bourdieu, 1975, 1991). Besides getting such recognition in the broader field through publishing, it was also important for Lian to get recognition for his leadership and its legitimacy in the isotope lab. As the former director and the technological authority, Wu was a powerful competitor. Though the current regime made it impossible for him to recapture his formal leadership, he was still a threat to Lian's social authority, especially when he mentioned the mistakes Lian had made in his administrative role. Consequently, Lian preferred to consult the manual and leaders of other institutes instead of using Wu as his source of technical knowledge. In contrast, Wu had made it well known that he was recruited to the isotope lab because of his expertise. He was proud of his technical ability and took it for granted that it should constitute the basis of authority. Nonetheless, Wu needed others' confirmation. So there were conflicting interests between Lian and Wu. Each attempted to advance his own interest by emphasizing the importance of his own superior capital and debasing the other's capability. Wu always claimed that, 'Spectrographic analysis needs many skills. The skills are accrued from long-term experience. You can't get it by just looking at the manual.'[29] Lian's point was, 'We should know how to do the experiment, but it's a dead end job if all we know is how to do the experiment.'[30] While Wu tried to reestablish his scientific authority by clarifying the value and difficulty of experimental technique, Lian hoped to consolidate his leadership by debasing the status of 'mere' technical know-how. They were using *subversion strategies* (Bourdieu, 1975: 30) and *conservation strategies* (Bourdieu, 1975: 29), respectively.

Wu often showed his resistance to the domination of theoretical capital, and complained about the neglect of technological capital:

> The experiment we are doing is not a simple repetition like those experiment demonstrations. We do have findings and innovations. But universities pay no attention to experimentation. They treat us as technicians. They only need the results and don't care about the process at all. Almost no one conducts research on methodology.[31]

Wu also cited another university to show the ignorance of experimental work in universities:

> People in UST are quite arbitrary. They seldom do any experiments and are not familiar with the samples. But they totally agree with those opinions given by overseas journals. In one conference, they insisted that it was impossible for varietal rock to crystallize. But I had found many crystallized varietal rocks in my samples. They are good at English, that's an advantage. But they often apply the parameters given by overseas research indiscriminately. In fact, many parameters are not fixed in value. They vary in different situations.[32]

Wu used this example to clarify the importance of technological capital in the field of geoscience, insisting that those who only have theoretical capital will encounter difficulties in gaining scientific authority due to their ignorance of technological problems. However, the downgrading of technological capital in the field constricted Wu's venues for publication, and his complaint was only heard by a few people around him.[33] Wu gave another example to show that technological capital could play a key role in the formulation of a new theory. A dogmatic theory had been raised by geoscientists at UST asserting that the Dabieshan mountain in China was formed by a one-off linear collision 200 million years ago. The proof was the 200-million-year old samples found to the east of the mountain. But Wu later analyzed samples from the western area of the mountain, and estimated that the samples were formed 400 million years ago. His estimate supported an alternative explanation of multi-collision theory. Even geoscientists at CU were at first skeptical of Wu's results, and the new theory was not put forward until similar experimental results were obtained by overseas researchers.[34]

As the subordinate, Wu hoped to ameliorate his situation by emphasizing the value of technological capital to resume its ascendant status. The *subversion strategies* (Bourdieu, 1975: 30) he used would not bring him any profit unless he succeeded in redefining technological capital as the preferred 'currency'. Given that Wu's behavior threatened dominant interests, it was understandable that Lian treated him rudely and conflict often occurred. In such a situation, Wu would suffer exclusion and discrimination if he still insisted on his opinion. Yet if he accepted the rules of the game, he would have to admit the inferior status of technological capital and resign himself to being dominated. Neither submission nor unfruitful assistance would change his status as a subordinate. This was Wu's dilemma.[35]

Shen was also a technique-oriented person. He was quiet and often wore a 'civilian' jacket in the isotope mass spectrometry lab, but changed to the white lab coat in the clean chemistry lab. Shen had worked in the old isotope lab for 9 years, and yet remained in a subordinate status despite his lengthy service. The change in capital validation affected his interests to some extent: he still needed recognition, but the source of the recognition changed from experimental scientists to theoretical scientists. Shen had been using publication as the way to accumulate technological capital and said to me, 'I seldom find any new idea in those published articles. But I am also indulging in writing those sorts of things, just for higher title.' Tracking Shen's publications shows an interesting pattern. He has been publishing papers on experimental methodology since 1993. After 1998, he began to appear as a co-author with Lian in the study of the Yangtze craton. In 2005, Shen even published a paper on the Yangtze craton as the first author. He also has been involved in more than seven research projects, sometimes as the principal investigator. This record shows how a game player successfully adjusted his habitus after encountering a new experience. Shen acknowledged that these papers might not be of high quality. The latest paper on the Yangtze craton merely verified an already existing theory. The point is, however, that he successfully increased his theoretical capital by gradually shifting the focus of his research from experimental work to theory-related work, which helped in gaining recognition from the new judges.

Zhu entered the isotope lab after the transition had been completed. As a former teacher in CU, she was exposed to the field of geoscience before entering the lab. Consequently, it was relatively easy for her to acquire habits that fit the new isotope lab. Zhu was a serious student who carefully followed the rules. She was the only group member who dressed in a white lab coat throughout the working day. She came to the lab everyday, observed Wu doing experiments and conducted experiments under his supervision. Zhu was quite talkative and outgoing. In contrast to the three male members who did not often talk to each other, Zhu maintained friendly relations with everyone. Though devoting herself entirely to experimental work, she expressed a different attitude than Wu: 'Only focusing on methodology will not bring good future for junior scientists. But, it's not bad if you are already in your fifties.'[36] Zhu had the same opinion as Lian: 'Experimental methodology is not a promising area. I'm considering other areas I should focus on. But you know, I have to complete the job here first.'[37] Zhu was far more interested in accumulating theoretical capital than in increasing her technological capital. She regarded theoretical capital as essential for her future career, while she took technical skills as necessary for completing her contract job.

Zhu and Shen were subordinates who identified with the domination of theoretical capital. They admitted that theoretical capital was superior to technological capital and were striving to increase their own store of it. Zhu and Shen both adopted *succession strategies* (Bourdieu, 1975: 30) by obeying the rules in the field, which would support their interests in their future careers. Because Wu was the only defender of technological capital, he was vulnerable to others' criticisms. Although forces from the MCS Open Lab triggered the shift, the informal relations in the isotope lab reinforced that shift.

Discussion

The bone of contention in the isotope lab was whether theoretical capital or technological capital should be the source of social authority. The controversy is not new. From the debate between Boyle and Hobbes in 17th-century England (Shapin & Schaffer, 1985) to the disputes in the famous Morgan genetics lab (Kohler, 1994), as well as in various large war-time projects (Galison, 1997), scientific authority based on technological capital is often challenged. As Bourdieu (1975:24) puts it:

> the debate between the principle giving primacy to observation and experimentation, and hence to the corresponding dispositions and capacities, and the principle which privileges theory and the correlative scientific interests, is one which has never ceased to be at the centre of epistemological reflexion.

Although modern science is to a large extent built upon experimentation and observation, the experimental work is traditionally disdained as manual labor, inferior to mental work (Whalley & Barley, 1997). Even Boyle, who promoted the use of experimentation in scientific research, failed to give his technicians much credit. Technicians doing the manual work were intentionally omitted from historical documents and artistic recreations of famous experiments (Shapin, 1989). Studies on technicians in modern scientific settings (Barley 1986, 1990, 1996; Barley & Bechky 1994; Barley & Orr 1997; Keefe & Potosky, 1997; Doing, 2004) further reveal that technicians often get little credit for their contributions to research. This idea is expressed in an old Chinese saying: 'Dominators work with their heads, subordinates work with their hands.'

Contrary to the idea of theoretical dominance, several laboratory studies reveal that technical work is intimately related to theoretical knowledge (Lynch, 1985; Nelson & Barley, 1992; Barley & Bechky, 1994). The technician has become a blurry category between scientist and craftsperson (Barley & Bechky, 1994; Barley, 1996; Whalley & Barley, 1997). Learning craft knowledge constitutes an essential part of doctoral training in biochemistry, physical geography, and earth science, as many PhD students have claimed (Pole, 2000; Delamont & Atkinson, 2001). Although improved recognition of technicians' contributions might not change the intrinsic hierarchy of scientific capital, they could help to redress the inequality.

Conclusion

In this paper, Bourdieu's field theory is used to explain the competition found in the isotope lab. My analysis of the case identified two forms of capital in the field of geoscience: theoretical capital and technological capital. Both forms are associated with scientific authority, but they compete for social authority in the specific local-historical situation. A shift in the proprietorship of the isotope lab in 1996 relocated it from a relatively independent technical setting to a research setting, and established a hierarchy of capital consistent with the broader geoscience field. From then on, theoretical capital had ascendancy for determining social standing and authority in the isotope lab, though it continuously faced a highly personalized challenge from a proponent (and possessor) of technological capital. To maximize their interests, group members applied different strategies. The current social authority figure applied *conservation strategies* (Bourdieu, 1975: 29) and the previous social authority figure applied *subversion strategies* (Bourdieu, 1975: 30). These opposing strategies emphasized the merit of the forms of capital the respective scientists primarily owned and debased the forms of capital their rivals stressed. These oppositions manifested in clashes and expressions of hostility in daily work situations.

It should be noted that the hierarchy of capital and the competition in the isotope lab were not simply endogenous developments. In the field of geoscience at large, technological capital is less appreciated than theoretical capital. And the low autonomy of scientific research in China further strengthens that hierarchy to facilitate decision-making by social authorities who lacks pure scientific authority. The conflict between two representative holders of technological and theoretical capital reveals that monetary resources, authority, and credit were mainly allocated to researchers with theoretical capital. The isotope lab thus became a microcosm of tendencies in the broader field.

One shortcoming of this paper is that I did not begin my observation before the transformation occurred, so I cannot compare the differences in the group members' behavior to describe the structuring and restructuring process more precisely. The data I used to depict the earlier situation were taken from personal recollections that are, of course, subject to hindsight and personal bias. However, my observations, interviews and archival information all suggest that there was a shift in the relative importance of technological and theoretical capital, and that we can see how this led to conflict in the lab.

Bourdieu's discourse on the scientific field, although it was available (and occasionally cited) during the anti-positivist movement in the sociology of science, has not drawn much attention in the science studies community.[38] The use of Bourdieu in this paper shows how the macro-level social structure can be relevant for interpreting micro-level observations; how the social construction of experimental results can be affected by hierarchies of scientific capital in the broader field. This line of reasoning adds a contextual dimension to ethnographic work that has often been criticized for concentrating on local activities while neglecting their embeddedness in a broader social context (Breslau, 2002). As the science studies literature begins to include more case studies from non-western cultures and political systems, such social and institutional contexts are essential for understanding what happens in local settings.

Studies on Chinese science have also been limited. This study examines developments and characteristics in the Chinese scientific community, analyzes the specificity of the field of geoscience, identifies China's relative status in the international field of geoscience, and provides an example of a struggle over capital in a Chinese isotope lab. The Chinese Communist Party could have been treated as an independent source of authority, but it was never invoked in this study. This lack of noticeable Party influence is consistent with the work of Walder et al. (2000), which shows that the Party is less relevant for professional workers than for administrators, suggesting that Party influence may vary with work organization (see also Walder, 1986). Taking Bourdieu's point of view, scientific fields may be more autonomous from the State than are other work fields in China, although still more dependent than those in the West. More systematic comparisons may help develop this important theoretical question. Similarly, as mentioned earlier, Confucianism prescribes age as a strong basis for authority. But this traditional dimension of age authority was not observed in the isotope lab. Future studies on the changes in the political and cultural dimensions of scientific authority in China, and on how they have intervened in the social construction process would be particularly interesting. Such studies would allow us to see if the relative role of traditional sources of authority are weakening as China shifts to a more internationally focused scientific community.

Notes

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1. Traweek (1988) noticed that the postdocs in a high-energy physics lab needed to compete for support from senior physicists. To present themselves as better candidates, derogating other postdocs' capability was a taken-for-granted strategy. In 17th-century England, when Boyle and Hobbes disputed whether experimentation should be regarded as a legitimate way of producing knowledge, each accused the other of endangering the social order (Shapin & Schaffer, 1985). In the famous Morgan lab where *Drosophila* became the standard fly for genetic research, clashes between generations intensified when Morgan declined to surrender his administrative power to his heir. And the lab's valuing of experimental work rather than intellectual ideas caused feelings of loss among those who were good at thinking but poor at doing (Kohler, 1994). In multiple weapons projects, collaborations between theorists and engineers were accompanied by conflicts and frustrations due to cultural differences. The leadership of engineers was severely challenged by theorists (Galison, 1997).
2. To protect the confidentiality of people involved in this study, all institutional and personal names are pseudonyms.
3. In the recent academic rush for bird flu research, a Russian scientist in the USA used two samples collected by a Chinese scientist without giving her proper credit. Consequently, in order to secure the publication priority of Chinese scientists, the Chinese Ministry of Agriculture became reluctant to share the latest samples (Zamiska, 2006). The unique access to samples, either bird flu or rock samples, expedited the process through which Chinese scientists were admitted into the world scientific community.
4. After the decision was made, the Lab Center expressed its resistance by turning off the central air-conditioning in the third floor where the isotope lab was located.
5. The POEMS II Lab was under construction, and would later provide similar services as the isotope lab.
6. For example, the mass spectrographic analysis involves the knowledge of nuclear physics, geochemistry, computers, and electric apparatus, and requires the experimenter to stay for hours during the experimental process. Scientists in the isotope lab all regarded it as the most difficult and vital part of the experiment. This is why I endow it with a high difficulty coefficient of C. Chemical separation and sample preparation are both simple manual work. Because the former involves chemical knowledge and demands extreme care during several experimental processes, while the latter is mechanical labor that requires less skill or knowledge, they are defined with lower coefficients of B and A respectively. As for Wu, since he took the three jobs together, I define the difficulty coefficient of his job as the highest: D.
7. The unpredictability of raw materials is a common problem for many organizations. How well an organization controls exceptional cases, either by reducing the variability of the material or by increasing knowledge of it and thus allowing more analytic techniques to be used, usually determines its structure (Perrow, 1967). From this perspective, the ability to deal with critical uncertainties is key to power with in the organization (Hickson et al., 1971). In the isotope lab, when all rhenium filaments were standard, the variability of the raw materials would be minimized to an easily understandable level, so the experiment would be easy to operate. Hence Wu's ability to deal with exceptional cases would not be a valued skill and he could not gain an expert role in the lab. In contrast, as for the actual situation in the isotope lab, the rhenium filaments were not uniform, thus the ability to decrease the uncertainty in analyzing results became very important and Wu was highly respected because of his expertise. In these two circumstances, the group structures differ due to the difference in raw materials.
8. The prepared sample is welded onto the rhenium filament before the mass spectrographic analysis.
9. Field notes: 14 April 1998.
10. Field notes: 6 April 1998.
11. Field notes: 28 April 1998.
12. Field notes: 10 April 1998.

13. Field notes: 15 May 1998.
14. Field notes: 9 July 1998.
15. Field notes: 20 May 1998.
16. Field notes: 26 March 1998.
17. CU is located far away from the city center.
18. Baoji is a remote city in another province.
19. Field notes: 10 September 1998.
20. Field notes: 16 June 1998.
21. Fieldwork experience is also a type of technological capital specific to the field. However, Lian was the only lab member who possessed such capital, and it never came up in the debate. Therefore it is excluded from the analysis in this paper. Actually, in an experimental setting such as the isotope lab, fieldwork skills could be seen as theoretical capital because only geoscientists doing theoretical research go to field. The effect of fieldwork skill as technological capital could occur in research settings where some scientists are good at locating samples while some others are good at writing papers.
22. Field notes: 10 September 1998.
23. Field notes: 10 September 1998.
24. A craton is the stable interior part of a continent that has existed for at least 500 million years and extends deeply into the mantle.
25. Field notes: 9 June 1998.
26. Field notes: 21 May 1998.
27. In fact, Guan himself was nominated as the director of the MCS Open Lab due to his extraordinary academic achievements by the age of 36. He was a typical case of being given authority based on ability instead of seniority.
28. The procedure of selecting the sample that is proper for analysis from the raw materials is accomplished before sample analysis. That is not a part of the routine job of the isotope lab.
29. Field notes: 24 March 1998.
30. Field notes: 16 April 1998.
31. Field notes: 16 June 1998.
32. Ibid.
33. It is worth noting that Wu cited the ability to speak English as an advantage – an important form of cultural capital – in this field. As Chinese geoscience reoriented increasingly toward the international science community, this cultural capital became increasingly important.
34. Many disciplines in China are relatively backward compared with those disciplines in developed countries. So, in terms of scientific capital, most Chinese scientists and researchers own less theoretical capital and technological capital than their Western counterparts. Hence, they regard results given by overseas researchers as more authoritative.
35. One could argue that Wu's loss of status was due to other factors. For example, Wu's personality might not be appealing to his colleagues, or the staff members in the MCS Open Lab might have preferred Lian because of his personal connections. From my observations, Wu had a pleasant personality and got along with his colleagues except Lian. Nevertheless, even for Zhu, who was learning from Wu and was fairly close to him, he was just a pathetic loser who was too old to escape from the dead end experimental work. Therefore, the marginalization of Wu was more relevant to his lack of theoretical capital than to his personality. Lian certainly had advantages in networking resources because his PhD supervisor was the former director of the MCS Open Lab and the current fellow of the academic committee, but it would be hard to differentiate this effect from my 'Bourdieuian' speculation – if Lian was elected as the head of the isotope lab just because of his advisor, this decision itself reflects an alliance between holders of theoretical capital and constitutes a part of the struggle over the rival form of capital. Therefore, although there might be other viable explanations, Bourdieu's theory seems to be proper for explaining what happened in the isotope lab.
36. Field notes: 9 June 1998.

37. Ibid.
38. Bourdieu (2004) makes this point about the neglect of the paper in his posthumously published book.

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