Ibn Sīnā (Avicenna): *al-Burhān min al-Shifāʾ* (*The Book of Demonstrations* of *The Healing*)

Isfahan, ca. 1027 CE

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Commentary

The Limit of Experience:

Ibn Sīnā on Success and Failure of Empirical Science

The words I am going to discuss were written almost a thousand years ago by Ibn Sīnā. Ibn Sīnā—maybe better known to you by the Latinized form of his name, Avicenna—was arguably the most influential philosopher in the premodern Islamic context. As such, his name, like no other, became associated with theoretical reflections about science and scientific methods. Ibn Sīnā might not have been the first who practiced and theorized about science; there were numerous others before him who contributed to the rise of various Islamic sciences. But he made use in an unprecedented way of the many works of science which were translated from Syriac, Greek, Persian, and other languages into Arabic when the ever-growing Muslim empire came to incorporate longstanding communities of learning.

Ibn Sīnā's words are taken from a much larger book, entitled *The Book of Demonstrations* (in Arabic *Kitāb al-Burhān*), which together with other books makes up Ibn Sīnā's *magnum opus*, *The Healing* (*al-Shifāʾ*). In *The Book of Demonstrations*, Ibn Sīnā has much to say about science, and he discusses two particular scientific methods: one he calls *istiqrāʾ*, which translates as "induction," and the other one he calls *tajriba*—and here the scholarly literature is somewhat in disagreement how this should be translated. We find "methodic experience" and "experimentation." I think "tried and tested experience" might be a suitable translation, but since that's quite a mouthful, let's just go for "experience."

Ibn Sīnā discusses these two methods because he is interested in examining their usefulness for science. The aim of science, Ibn Sīnā tells us, is to attain certainty about the things it investigates. Scientific statements about the world are not merely supposition or guesswork, but entail certain, definite knowledge. Scientific statements then come in the form of universal propositions, like "all As are B," expressing a truth about all As, not just some particular instances of them. The question Ibn Sīnā asks is

whether induction and experience live up to the high standards of science, and whether they can yield certainty.

The two methods, you might have gathered from Ibn Sīnā's own words, are not entirely different; for one thing, they are both strikingly empirical, starting from observation and experiences of the world around us. Ibn Sīnā was actually a staunch defender of empirical science, even though there is some room for debate about the extent of that loyalty. But there are also striking differences between induction and experience, and these differences led Ibn Sīnā to reach two very different verdicts about their respective usefulness in science:

Induction, he concludes, might theoretically be a sound scientific method, but in reality it hardly lives up to what it promises. Experience, on the other hand, is more modest in its claims and therefore much more useful for science.

Let us unpack what Ibn Sīnā wants to say in the excerpt—and admittedly his account isn't the most straightforward and really does need some unpacking.

I'll start with what he tells us about induction. Induction, as you will probably know, considers particular instances of some thing in the world around us, and then arrives at a universal judgement about them. The example Ibn Sīnā mentions is that something that is touched by two objects, which are however not touching each other, must be divisible. We come to believe that this is a universally true judgement about all such things because we have come across a certain number of particular instances of it.

But this is, according to Ibn Sīnā, precisely where the problem with induction lies: We have only come across a limited number of cases, but for induction to produce certainty, expressed by a universal statement, we need to take into account *all* relevant cases. "Induction has to give an *exhaustive* account of *all* [particulars]," says Ibn Sīnā, "or it only brings about supposition and probable belief."

Sure, a limited number of cases can "alert" our minds to the universal, can give us a hint, we might want to say, of the universal judgement. But this is not enough to occasion the degree of certainty that is necessary in order to live up to the high ideals of scientific enquiry.

In another of his works, entitled *Danesh Nameh* or *The Book of Science*, Ibn Sīnā gives an example that vividly illustrates the problem he has with induction. Consider the universal statement that "all animals, when they chew, move their lower jaw." You might think you have discovered a truth about the chewing habits of *all* animals when you observe the vast majority of them. But Ibn Sīnā reminds us that we might have overlooked one animal, which proves the allegedly true universal judgement to be false: the crocodile, which chews by moving its upper jaw.

This example illustrates why Ibn Sīnā insists that induction can only occasion certainty if *all* particulars have been identified and taken into account. And what is more, certainty only comes about when one can give a reason why it should be true to say of all As that they are B. Simply to maintain that all As are B, without being able to explain just why this should be true, is not enough according to Ibn Sīnā's scientific standards.

Most people, however, are not very inclined to take such trouble, and Ibn Sīnā remarks derogatorily that it is mainly sophists who pretend to proceed scientifically.

In light of his critique of induction, Ibn Sīnā then explains tried and tested experience.

In a nutshell, there are two main differences between induction and experience:

Firstly, while induction has to be an exhaustive account of all particulars, experience can make do with only a limited number of particulars.

Secondly, while induction usually only leads to probable belief, and at best "hints" at a true insight, experience does achieve certainty and justifies universal judgements—however, with one small, yet important caveat: Experience leads to "universal knowledge *with a condition*," as Ibn Sīnā states. But more on the significance of this in a bit.

So, experience is not so different from induction in that it, too, starts from empirical data and in that it aspires to a universal judgement. Ibn Sīnā's favorite example to illustrate how experience works seems to have been the judgement that "scammony purges bile," but he also mentions the judgement that "the magnet attracts iron." In case you are unfamiliar with the medicinal properties of the scammony plant, let me just note that in Ibn Sīnā's times it was used as a laxative.

How, then, do we arrive at this judgement? We do so, Ibn Sīnā explains, when we observe repeatedly, and many times, that administering scammony to a patient results in the purging of bile. It is important, Ibn Sīnā emphasizes, that this is observed many times, for this justifies the conclusion that it is not a matter of chance and coincidence, but that purging bile is a necessary property of scammony, that it lies in the very nature of scammony to cause this particular effect. Underlying this reasoning is the principle that "what is by chance does not happen always or for the most part," to quote Ibn Sīnā.

Sure, at this point we might not know yet what exactly it is about scammony that causes the effect in question; Ibn Sīnā leaves it open whether it is the scammony plant itself, or an associated power, as he calls it, or some special property or something entirely different. But this matter of detail is not really important; what is important is that we are able to say that we have uncovered some cause, namely "a power to purge," which vindicates our statement that "scammony purges bile." To say that we have uncovered the existence of a cause might not be as scientifically desirable as to say what exactly the cause is—but it is already much more, and much closer to the ideals of science, than what induction is able to do.

At this point, Ibn Sīnā introduces a hypothetical interlocutor—a frequently used rhetorical strategy in premodern Islamic texts—who puts forward a weighty challenge. Essentially, the interlocutor points out that it makes little sense to claim that experience but not induction should occasion the desired scientific certainty, if both methods have in common that they consider only a limited number of particulars. After all, we surely never observed how all scammony plants behave if administered to patients.

The interlocutor puts forward an example, or maybe a thought experiment, to illustrate his point. Wouldn't we, he argues, be necessarily convinced that "all people are black" if we only ever came across black people? Following Ibn Sīnā's account of experience, this universal judgement should be necessary for us. But if it were necessary for us, the interlocutor continues, then something that we know as a matter of fact to be false—for there are of course people who are not black—would have become necessary. The method of experience would then impose something on us as necessary that is an error, and this is hardly useful for science.

Ibn Sīnā of course set up this thought experiment in way that would allow him to nicely illustrate exactly how experience works. To summarize, in his reply, Ibn Sīnā stresses that the interlocutor made the mistake of going beyond the domain of experience, as it

were. What does this mean? The interlocutor's mistake was that he observed *black* people and their offspring, but then arrived at a judgement about *all* people, which includes people of all skin colors. He should have restricted himself in his judgement to the precise domain his experience was applied to, and only said something about black people. Then, his case of experience would have been successful.

The same rule applies to the case of scammony, Ibn Sīnā remarks. This is why the judgement that "scammony purges bile" has to include the condition that this is a judgement about "the scammony plant known to us and observed by us," which is "in our region," as Ibn Sīnā insists. It might well be, he concedes, that there exists a scammony plant, maybe a different variety, somewhere else which happens to have different properties than our scammony plant, and which would fail to cause the purging of bile.

All of this illustrates that the scientist, who makes use of the method of tried and tested experience, has to be well aware of specific conditions and circumstances. And, finally, it also explains why Ibn Sīnā insisted that experience does lead to certainty and a universal judgement—but only "with a condition," and that condition is the specific domain in which experience was done, to the exclusion of all other possible particulars.

So, there you are! Ibn Sīnā taught us that observation and experiences of the world plays an important role in science. But there are different ways in which one could make use of such experiences, and not all of them are equally useful. Scientists who observe the "rule" proclaimed by Ibn Sīnā, however, should be well prepared for their task.

Further Reading

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Source Text

Ibn Sīnā, البرهان من الشفاء (*al-Burhān min al-Shifāʾ*; "The Book of Demonstrations" of "The Healing"), edited by ʿAbd al-Raḥmān Badawī (Cairo: Dār al-Naḥḍa al-ʿArabiyya, 1966). From https://www.noor-book.com

Section 1 = excerpt from pp. 45–48 = I.9

Section 2 = excerpt from pp. 161–62 = III.5

Section 1

وأما التجربة فإنها غير الاستقراء . وسنبيّن ذلك بعدُ . والتجربة مثل حكمنا أن السقمونيا[1] مُسهل للصفراء فإنه لما تكرّر هذا مراراً كثيرة زال عن أن يكون مما يقع بالاتفاق [٤٥ ب] ، فَحَكَمَ الذِّهْنُ أن مِنْ شأْن السقمونيا إسهال الصفراء [...] و إسهال الصفراء عَرَضٌ لازم للسقمونيا .

ولسائل أن يسأل فيقول : إن هذا مما لا يعرف سببه ؛ فكيف يقع هذا اليقين الذى عندنا من أن السقمونيا لا يمكن أن يكون صحيح الطبع فلا يكون مسهِّلاً للصفراء ؟

أقول : إنه لما تحقق أن السقمونيا يعرض له إسهالُ الصفراء وتبيَّن ذلك على سبيل التكرار الكثير ، عُلِمَ أن ذلك ليس اتفاقاً ، فإن الاتفاق لا يكون دائماً ولا أكثرياً ، فعلم أن ذلك شيء يوجبه السقمونيا طبعاً [...] لو علم أن الجسم — بما هو جسم — لا يوجب هذا المعنى ، فيوجبه بقوّة قريبة فيه أو خاصّة له أو نسبة مقرونة به .

فصحّ بهذا النوع من البيان أن فى السقمونيا بالطبع أو معه علة مسهلة للصفراء . والقوة المسّهلة للصفراء إذا كانت صحيحة وكان [٤٦ ا] المنفعل مستعداً ، حصل الفعلُ والانفعال ؛ فصحَّ أن السقمونيا فى بلادنا يسّهل دائماً الصفراء إذا كانت صحيحة . — فإذن عرفنا الأعظم للأصغر بوساطة الأوسط الذى هو القوّة المسهّلة وهى السبب . [...]

ولقائلٍ أن يقول : ما بال التجربة تفيد الإنسان علماً بأن السقمونيا تسّهل الصفراء على وجهٍ يخالف فى إفادته إفادةَ الاستقراء ؟

فإن الاستقراء إما أن يكون مستوفى الأقسام ، و إما أن لا يوقع غير الظن الأغلب . والتجربة ليست كذلك .

ثم يعود فيتشكك[1] فيقول :
ما بال التجربة توقع فى أشياء حكماً يقينياً ؟ ثم لو توّهمنا أن لا ناسَ إلاَّ فى بلاد السودان ، فلا يتكرر على الحس إنسانٌ إلا أسود — فهل يوجب [٤٦ ب] ذلك أن يوقع[2] اعتقاداً بأن كل إنسان أسود ؟ فإن لم يوقع فلم صار تكرر يوقع ، وتكرر لا يوقع ؟ و إن أوقعت فقد أوقعت خطأً وكذباً ؛ و إذا أوقعت خطأً وكذباً ، فقد صارت التجربة غير موثوق بها ولا صالحة لأن تكتسب منها مبادئ البراهين .

فنقول فى جواب ذلك : إن التجربة ليست تفيد العلم لكثرة ما يشاهد على ذلك الحكم فقط ، بل لاقتران قياس به قد ذكرناه . ومع ذلك فليس تفيد علماً كلياً قياسّياً مطلقاً ، بل كلياً بشرط ، وهو أن هذا الشىء الذى تكرر على الحسّ يلزم طباعه فى الناحية التى تكرر الحسّ بها أمراً دائماً ، إلاّ أن يكون مانعٌ فيكون كلياً بهذا الشرط ، لا كلياً مطلقاً . فإنه إذا حصل أمرٌ يحتاج لا محالة إلى سبب ، ثم تكرر مع حدوث أمرٍ آخر عُلِم أن سبباً قد تكرر . [...]

واعلم أن التجربة ليست تفيد إلاّ فى الحوادث التى على هذا السبيل ، و إلى هذا الحد . و إذا اعتبرت هذا القانون الذى أعطيناه ، سهل عليك[1] الجواب عن التشكك المورد بحال الناس السود فى بلاد السودان وولادتهم السود . و بالجملة ، فإن الولادة إذا أُخِذَتْ من حيث هى ولادة عن ناسٍ سود أو عن ناسٍ فى بلاد كذا ، صحّت منه التجربة . وأما إن أخذت من حيث هى ولادة عن ناسٍ فقط ، فليست التجربة متأتية باعتبار الجزئيات المذكورة ، فإن تلك التجربة كانت فى ناسٍ سود ، والناس المُطْلَقون غيرُ الناس السود [...]

ولسنا نقول إن التجربة أمانٌ عن الغلط [والقياس[3]] و إنها مُوقِعةٌ لليقين دائما . [...] بل نقول : إن كثيراً ما يعرض لنا اليقين عن التجربة ، فنطلب وجه إيقاع ما يوقع منها اليقين . [...]

فإنّا أيضاً لا نمنع أن يكون السقمونيا فى بعض البلاد[1] يقارنه مزاج وخاصّية ، أو يعدم فيه مزاج وخاصّية لا يسهل ، بل يجب أن يكون الحكم التجربى عندنا هو أن السقمونيا المتعارف عندنا المحسوسَ لدينا هو لذاته أو لطبعٍ فيه يسّهل الصفراء ، إلاّ أن يقاوم بمانع . [...]

Section 2

وأما الكائن بالاستقراء [...]

فإذا استقرأ جزئياته يُنَبِّهُ[2] العقل على اعتقاد الكلّى من غير أن يكون الاستقراء الحسّى الجزئى موجباً لاعتقاد كلى ألبتة ، بل منبّهاً عليه ، مثل أن المماسين لشىء واحدٍ وهما غير متماسين يوجبان قسمة لذلك الشىء . فهذا ربما لا يكون ثابتاً مذكوراً فى النفس ، فكما يحسّ بجزئياته يتنبه له العقل و يعتقده .

وأما الـكائن بالتجربة فـكأنه مخلوط من قياسٍ واستقراء ، وهو آكد من الاستقراء ، وليس كالاستقراء ، فإن [...]
الاستقراء لا يوقع من جهة التقاط الجزئيات علماً كلياً يقينياً وإن كان قد يكون منبّهاً ، وأما التجربة فتوقع ، بل التجربة مثل أن يرى الرائى أو [١٧٨ ا] يحسُّ الحاسُّ أشياءَ من

نوعٍ واحدٍ يتبعها حدوث فعلٍ[١] وانفعالٍ . فإذا تكرر ذلك كثيراً جدًّا حكم العقل أن هذا ذاتىٌّ لهذا الشيء وليس اتفاقياً عنه فإن الاتفاق لا يدوم . وهـذا مثل حكمنا إن حجر مغناطيس يجذب الحديد ، وإن السقمونيا تسهل الصفراء . [...]
فهذه الوجوهُ[٣] التى نستفيد بها من الحس علوماً كثيرة ومبادئَ للعلوم كثيرة ، والتجربة منها فإنّ التجربة[٤] كأنها خلط من استقراء حسّى وقياسٍ عقلى مبنيٍّ على اختلاف ما بالذات وما بالعرض : فإن( ) الذىْ بالعَرَض لا يدوم .

Translation

By Hannah C. Erlwein. All emphasis added.

Section 1

Tried and tested experience is different from induction. We will clarify this in what follows. Experience is like our judgement that "scammony purges bile." When this occurs repeatedly and many times, then this ceases to be by chance, and our mind judges that purging bile belongs to scammony [...], and that purging of bile is a necessary accident of scammony.

Someone could ask: This is something where the cause [of it] is not known. So how can we be certain that scammony might be sound of nature and yet not purge bile?

To this, I reply: Since it has been established that the purging of bile happens to belong to scammony, and this has become clear thanks to much repetition, one knows that this is not *by chance*, for what is by chance does not happen always or for the most part—so

it is known that this is something scammony *necessarily* brings about, by its very nature […]. Had it been known that the *body* of scammony, insofar as it is a body, doesn't necessitate this thing, then it would have to necessitate it due to an *associated power* in it or due to some *special quality* it has or due to some *relation* with it.

This sort of explanation makes it clear that there exists a cause in scammony, either by nature or associated with it, which brings about the purging of bile. When the power to purge bile is sound, and when the patient is suitably disposed, the action [of purging] and the affection [of being purged] both occur. This also makes it clear that scammony in our region purges bile always, if it is sound. So we know that [in a syllogism which we can construct on this basis] the major term belongs to the minor term, by means of the middle term, which is "the power to purge bile" and which is the cause. […]

Someone could [still] ask: What is the difference between the way in which experience provides humans with knowledge that scammony purges bile, and the way in which induction does so?

[I reply:] Induction has to give an *exhaustive* account of *all* [particulars], or it only brings about supposition and probable belief. Experience is not like this.

Now the interlocutor might raise another doubt: And why is it that experience should bring about a judgement about things that is *certain* [unlike induction]? For, were we to imagine that there are only Sudanese people, and that one observed repeatedly only black people, wouldn't this make it necessary to be convinced that "all people are black"? If it were not necessary [to be convinced that all people are black], why then does one case of repeated observation make some conviction necessary but another case of repeated observation does not make some other conviction necessary? And yet, if [the conviction that all people are black] were indeed necessary, then something that is [in fact] false and an error would have been made necessary. But if something that is [in fact] false and an error should be made necessary, then experience turns out to be unreliable and not suitable for acquiring the principles of demonstrations.

We would reply this: Experience does not provide this knowledge simply because of the frequency of observations leading to this judgement, but because a syllogism is connected with it, as we mentioned before [i.e., that this must be due to nature, not by chance]. Nevertheless, experience does not provide *absolute*, syllogistic, universal knowledge, but [only] universal knowledge *with a condition*, and this condition is that the character of this thing, which presents itself repeatedly to our senses, is necessary and occurs always in the domain which is repeatedly observed, as long as there is no obstacle. This is why [the knowledge attained from experience] is universal *with this condition*, and not *absolutely* universal. When something occurs that requires a cause, and moreover when it repeatedly occurs with something else, then it is known that a cause has happened repeatedly. […]

You should know that experience is of good use only with things happening in this way and according to this description. When you consider this rule which we just formulated, then the reply will be easy for you to the doubts that were cast about the case concerning the Sudanese people and their procreation. In a nutshell, if procreation is understood as procreation of *black* people or people of such a region, then experience

works. But if procreation is understood as procreation from *people [in general]*, then experience will not be expedient, if only the aforementioned particulars are considered. The reason is that, in the latter case, experience would be based on *black* people, but people *in an absolute sense* are not black people [alone]. […]

We do not claim that experience is a safeguard against error or always leads to certainty. […] What we say is that frequently we have certainty thanks to experience, and this is why we want to understand how and when it brings about certainty. […]

We will then not exclude the possibility that in some [other] region, scammony has a mixture or special property, or is lacking a mixture or special property, which causes it to fail to purge [bile]. This makes it necessary that the verdict reached by us based on experience is [simply] that the scammony plant known to us and observed by us purges bile by its essence and nature, as long as there is no obstacle. […]

Section 2

So, as for the things we derive from induction: […] When one considers particular things inductively, then reason is *alerted* to believe in a universal [judgement]. But induction based on sensible particulars can never make belief in a universal [judgement] *necessary*, it can only *alert* to it. Take as an example this: Two things which both touch a third thing, but which do not touch each other, make [the universal judgement] necessary that the third thing can be divided into parts. This might be something that is not evident to the soul, but once particular instances of it are observed, reason is *alerted* to it and comes to believe it.

As for things we derive from experience [, on the other hand]: They are a combination of a syllogism and induction, and this brings about more certainty than induction does. […] Experience is different from induction. Induction does not bring about certain, universal knowledge when it considers particular things, but only alerts to it—experience, however, achieves this. Experience is when someone sees or observes that [different] things of one and the same kind are followed by the occurrence of a given action and a given affection. If this happens repeatedly, many times, reason comes to judge that this is due to the essence of the thing, and does not happen as a matter of chance, for what is by chance does not occur always. An example of this is our judgement that "the magnet attracts iron," and that "scammony purges bile." […] There are several ways in which we derive, thanks to the senses, much knowledge, and many principles of the sciences, and experience is one of them. It is as if experience were a combination of induction based on the senses and a rational syllogism based on the difference between what is essential and what is accidental. For what is accidental, does not happen always.