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Before the First Recorded Case: Evgeny Rothschild and the Organisation of Research in Infectious Ecology

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Abstract

Research on an outbreak often begins with the first recorded case. By then, some of the environmental changes relevant to its emergence may already have occurred. This conceptual article uses Evgeny Rothschild's work on natural plague foci to examine how the organisation of research shapes what can be observed before an outbreak. Rothschild proposed that changes in geochemical conditions might influence the expression of pathogenic properties in microorganisms. His field observations raise questions that require comparisons across locations and across periods of both detected activity and apparent quiescence. The history of plague research at the Microbe Institute in Saratov illustrates how a scientific organisation can sustain the fieldwork needed for such comparisons while also shaping which questions receive continued attention. The article proposes using Scientific Recognition Architecture and problem-oriented research information systems (PORIS) to define the stages of the process under investigation, document gaps in observation, and specify what evidence would distinguish competing explanations.

Keywords: Infectious ecology, natural plague foci, Evgeny Rothschild, outbreak emergence, geochemical conditions, Scientific Recognition Architecture, problem-oriented research information systems.

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The First Recorded Case as an Observation Boundary

The first recorded case gives an investigation a date and a location. It also marks a boundary in the evidence. Once disease has been detected, investigators can compare cases, reconstruct possible routes of transmission and look for earlier events that may have contributed to the outbreak. Whether they can reconstruct those earlier events depends on what was being observed before anyone had a reason to investigate that particular outbreak.

For the purposes of this article, the expression ‘first recorded case’ refers to the earliest case documented by the surveillance or research programme under discussion. Its date depends on where, when and how observations were made. At a site where no cases were recorded, the available evidence may come from repeated surveys with documented effort, from occasional visits or from no survey at all. These records support different conclusions. A period of apparent quiescence can be interpreted only in relation to the observations that produced it.

This is where I see a specific role for infectious ecology. Its task is to investigate the processes in the natural system that precede the cases studied by epidemiologists. Changes relevant to pathogenicity may also occur without a recorded case, making sustained observation necessary even in periods with no recognised outbreak. The two bodies of evidence can be brought together by matching observations in space and time and by documenting how each was obtained. Rothschild’s work makes this task concrete because he asked what changes within a natural plague focus before an epizootic becomes visible through disease in animals [1].

Consider two sites where the first cases are recorded in the same week. At one site, repeated visits before detection yielded negative results. At the other, the first case was found on the first visit of the season. The dates of detection coincide, but only the first site offers observations that help delimit the interval in which the change may have occurred. Even there, the length of that interval depends on how frequently the site was visited and what the surveys could detect. Before interpreting synchrony as a feature of the natural process, we need to establish how much of it can be inferred from the observation schedules.

Rothschild’s Geochemical Hypothesis

Rothschild treated the capacity to cause disease as a property of microorganisms whose expression may depend on conditions in the surrounding system. In his ecological account of infection, he proposed that changes in geochemical conditions could contribute to the expression of pathogenic properties. This proposal led him to examine observations that a programme focused on recorded cases and their transmission might have little reason to collect systematically [1].

In Chapter 8 of Infections in Nature, Rothschild discusses episodes in which rises and declines in plague activity among rodents occurred at approximately the same time in widely separated regions. He also examines the association of plague activity with groundwater levels and considers differences between landscapes. Elsewhere in the book he reports comparisons of trace-element concentrations in plants, including

lower copper concentrations in samples from sites where epizootics were observed. These are distinct lines of evidence. The coincidence in timing raises a question about changes operating across regions. The chemical measurements concern particular places and sampling dates. Establishing a connection between the two would require observations on a comparable spatial and temporal basis [1].

The copper example shows what the hypothesis demands. Suppose plant samples collected during an epizootic have lower copper concentrations than samples from a comparison site. The difference could have preceded the epizootic, could reflect a persistent difference between sites, or could be associated with another condition that changed at the same time. Moreover, plant chemistry is a measurement in a particular part of the system. A proposed mechanism linking that measurement to the expression of pathogenic properties must specify the intervening steps and what evidence could support each one. Rothschild's observations make the questions concrete. Their causal interpretation depends on the sequence of events, the comparability of samples and the evidence for those intervening steps.

The hypothesis is most informative when it specifies the scale at which a change is expected. Measurements from a few plots can support a local comparison. Explaining concurrent changes in plague activity across distant regions would require observations at the corresponding regional scale. The two inquiries can inform each other if the sampling design shows how individual plots represent the sites and regions being compared. Otherwise, even a consistent association at the plot level leaves the regional question open.

How Research Organisations Shape Observation

The published record associated with Innokenty Soldatkin's group at the Microbe Institute in Saratov shows the breadth of the problem as it was studied in the Soviet anti-plague system. Soldatkin and Rudenchik examined the rodent–flea–pathogen system and later revisited the concept of the epizootic process. Rothschild's earlier work addressed the spatial structure of a natural plague focus and methods for studying it. These publications document a programme in which the distribution of animals, the organisation of a focus and the timing of epizootics could be studied together [2–4].

My historical account in the Russian introduction draws on that published record and on my later contact with Rothschild [5]. I met him in Moscow in 2010 while preparing the first Kyiv edition of his book. Those meetings belong to the history of the book and to my understanding of the questions Rothschild pursued. The published studies provide the evidence for what the earlier programme investigated.

A research organisation can sustain repeated visits to the same sites, keep records comparable over time and bring field and laboratory specialists into the same programme. Its decisions about which observations to maintain also set practical limits on the explanations researchers can test. A programme may keep excellent records of cases and vectors while holding only scattered measurements of the environmental conditions that preceded an outbreak. Years later, a researcher may be unable to

reconstruct the missing sequence even if the original investigators collected every measurement their protocols required.

The institutional question, then, concerns how a research programme responds when an observation exposes a gap in its own design. Who can propose a new line of observation? How is the proposal evaluated? Can records that are difficult to interpret be retained with their original context and reconsidered later? A programme's answers affect which questions remain open and whether the evidence needed to address them will exist.

This problem also has a practical source in the way scientific work is rewarded. A team can report a detected epizootic within a project cycle. Maintaining a comparable series of observations through several quiet seasons may yield little that can be reported in any single year. If funding and career evaluation favour results that can be reported quickly, the observations most useful for reconstructing an outbreak's prehistory may be the hardest to sustain. This is a general feature of research design. The case of Rothschild makes it possible to ask how responsibilities for maintaining such observations could be assigned in practice.

Designing Observations Before the First Case

Scientific Recognition Architecture provides a way to state explicitly which parts of a changing process a programme is designed to observe, how its measurements represent those parts, and what would warrant revising an explanation [5, 6]. A problem-oriented research information system (PORIS) can put those decisions into practice. It can preserve observations alongside their provenance, record which observations are missing, and connect each proposed explanation to the evidence that could strengthen or weaken it.

In the copper example, a study could follow a set of sites through periods with and without recorded epizootics. Sampling dates, locations, plant species, material sampled and analytical methods would be recorded alongside each measurement. Each site visit would also record the effort made to detect plague activity and the outcome of that effort. The resulting record should distinguish negative results, inconclusive observations and measurements that were never made. This distinction is essential when a gap in sampling falls just before the first recorded case.

A practical way to make these distinctions is to register the intended observations before the field season and record what happened to each one. If a scheduled visit is missed, the record should retain its date, site and reason for cancellation. If samples are collected but analysed with a different method, the record should identify where that change occurred. This makes it possible to inspect the evidence around the first recorded case and decide which comparisons are defensible. It also makes gaps visible while the programme can still adjust its sampling.

The comparison would then ask whether the geochemical change preceded detection, whether it also occurred at comparable sites without recorded cases under similar observation effort, and whether the pattern recurred across periods. A record showing that copper concentrations were consistently low at a site long before and after an

epizootic would change the interpretation of a one-time comparison. Finding the same change at adequately monitored sites without recorded disease would raise further questions about the conditions under which the proposed relationship might hold. If the observations needed to make these comparisons are missing, the system can identify which places, periods and measurements should be prioritised in the next field campaign.

A transmission-based explanation and a geochemical explanation may both account for some of the same observations. Their implications can be compared by asking whether the timing of changes is consistent with spread between sites, whether comparable environmental shifts preceded detections at separated sites, and whether the proposed environmental association persists once differences in surveillance effort are taken into account. A combined explanation can also be examined where the data support it. The system should preserve these alternatives and the reasons for revising them. Decisions about what to record, how strongly to interpret a result and whether to sustain an explanation should be open to independent scrutiny within the research programme. A team can then revisit its working account as new observations arrive and retain a record of which evidence prompted the change.

The division of responsibilities matters here. Field teams can document what was observed and under what conditions. Researchers proposing an explanation can state the observations on which it depends. Other members of the programme can assess whether those observations support the proposed inference and identify unresolved questions. PORIS can preserve each of these contributions, so that a later change in the interpretation remains traceable to the evidence that prompted it.

Conclusion

Rothschild’s work makes the interval before the first recorded case a subject of inquiry in its own right. His book asks what must be observed during apparently quiet periods so that a later outbreak can be interpreted in the context of changes already under way. Answering that question requires field observations that can be compared across places and periods, explicit records of what was missed, and an organisation willing to revise its explanations as the evidence changes.

Source Note

This article draws on my historical and scientific introduction to the 2026 Russian-language reissue of Evgeny Rothschild’s Infections in Nature: An Ecological Concept [5]. It develops the methodological question of how to design observations of infectious processes before the first recorded case of disease. Background on Rothschild is available on the journal’s Professor Evgeny Rothschild page.

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Conflict of Interest

The author declare no conflict of interest.

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Data Availability Statement

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