Manifesto for a Chemical Geography

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Inaugural lecture, Gustave Tuck Lecture Theatre, UCL
24th January 2017

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SECTION 1: Satin Island

The narrator of a recent novel by the author Tom McCarthy, *Satin Island*, is a corporate anthropologist called U. Throughout the book, U. struggles to write the 'Great Report', which will somehow sum up our present condition. He has been asked to write the report by the charismatic Peynman, head of the Koob-Sassen Project. In a dramatic and critical moment in the novel, U. renounces the generalisations of the great structural anthropologist Claude Lévi-Strauss, who had influenced his work up to then, and instead choses to immerse himself in the world of events and situations: in the world of the contingent, contested and frequently inexplicable, in other words.

Perhaps not surprisingly, U. tends to encounter events on screen and we meet him first in Turin airport, flicking between news reports on his computer.

But the events in U.'s life often have a chemical element. He is fascinated by an oil slick, and tracks its movement on his laptop. He is concerned with how doctors have injected his friend Petr, who has cancer, with orange juice. And he ends up meditating on the multiple resonances of different combinations of the letters of the word STATEN – political, chemical, cultural – as he observes the waste of New York being deposited in Staten Island: hence Satin Island. Satin is, of course, a product of the chemical industry, a weave of natural and artificial fibres.

McCarthy freely admits to borrowing from the work of anthropologists. Moreover, his novel might be confused with a treatise, or an essay, a confession or a manifesto (all these terms are both listed and erased on the cover). So, in a reciprocal gesture, I start from McCarthy's depiction of a world in which material and visual traces of chemicals are pervasive. My lecture is both a manifesto and a report on past and future work; not a novel at all, but like U.'s narrative, it is also a story about events too.

Although I think U. is a rather unattractive figure in McCarthy's book, my own work has some similarities. Like U. I am interested in the possibility of a geography of things as they happen; of events and situations. Like U, I am interested in chemicals.

I'm going to return to talk about some of my own fieldwork later, but I start with my title. Chemical Geography, which is an invented term: to my knowledge, as yet there is no such field and I am not proposing to establish a new Department! The word is intended to be performative: to mobilise or gather together at set of concerns with the study of chemicals in the field.

SECTION 2 Geography: between Geopolitics and Physical Geography

One way of positioning the discipline of Geography would be to locate it somewhere along the line between the study of geology and the analysis of geopolitics – at least how the project was sometimes formulated in the 19th century. In 1887 the Oxford geographer Halford Mackinder famously reckoned that social and political geography had to be grounded in an analysis of what he called the 'realities' of physical geography including, in particular, the geographical distribution of continental landmasses and oceans:

Mackinder, as far as I am aware, never had much interest in chemicals. However in 1918, only a month before the Armistice, William Jackson Pope, Professor of Chemistry at Cambridge, who served on the chemical warfare committee of the Ministry of Munitions, "called for a new sub-division of knowledge" which he called chemical geography

Pope's proposal was addressed to an audience of school teachers at Regent Street Polytechnic, now the University of Westminster:

> "the study of chemical geography" he contended, "would seem to be of prime importance to such an empire such as ours, in one corner or another of which is to be found in paying quantities practically every raw material for which mankind has found use. The study of chemical geography at once makes clear that if Germany loses control of the coal, iron and potash deposits in the West, and the Galician oil wells in the East, and is deprived of the handling of the raw materials produced abroad, the German empire falls automatically into the position of being a fourth rate power"

Pope's proposed sub-division of knowledge didn't materialize, and the term chemical geography never gained widespread currency. Moreover the study of political geography and geopolitics became progressively decoupled from what Mackinder termed 'geographical realities' – mountains, continental landmasses and so on- reflecting widening schisms between geology, physical geography, human geography, and geopolitics over the course of the 20th century. If Geography has continued to try to walk along the path between two points - geology and geopolitics - then this path is often difficult to perceive. The great land masses of the discipline have pulled apart.

My insistence today is that the connections between human and physical geography still matter, although they matter in new ways. And my proposition is that Pope's term – chemical geography – needs to be reinvented.

My proposal does not come out of the blue. The divide between human and physical geography is beginning to shift in productive ways, manifest in the emergence of a series of new approaches to thinking about the relation between politics, human geography, and the earth and the geo sciences.

These include: an expanding literature on the concept of the Anthropocene that addresses the question of the relation between 'geological' and modern human history; studies of the geopolitics and government of the below and the above ground, drawing inspiration from Foucault's analyses of territory and governmentality; increasing public participation in environmental research; a growing interest in the materiality and making of resources; vitalist explorations of the geo; investigations of shifts and movements in human population over the course of the Holocene; studies of geographical and geoscientific practice including fieldwork and modeling; studies of the politics and ethics of geoengineering; historical and sociological studies of controversies in the geosciences, including a voluminous literature on plate tectonics; research on geohazards, such as landslides, floods and earthquakes, and analyses of the key role of the 'geological industries', including the oil industry, in the development of the earth sciences

SECTION 3: Chemistry, an absent presence

Despite this efflorescence of connections between physical and human geography social scientists have systematically neglected the study of chemistry, although there is a growing interest in what has been called 'elemental geography'. And one of my core aims this evening is to show why this neglect of chemistry and chemicals matters - not just to geography but to the social sciences and humanities more broadly – and particularly for studies of geopolitics, reformulating the preoccupations of Mackinder.

Before we do this, why has this been so? Why have chemicals been so seemingly neglected? I give two reasons:

1. One reason is the continuing prevalence of the view that physics provides the foundation for scientific thought and, as a result, chemistry is in essence merely applied physics. This is an assumption most recently contested by the Belgian philosopher Isabelle Stengers who has argued that the classical (chemical) understanding of thermodynamics is irreducible to the dominant statistical (physicists') understanding of thermodynamics. Stengers' argument can be simply stated. Chemistry, a field that deals with shifting combinations and open systems, is not reducible to physics. Stengers' challenge to the conventional hierarchical order of the disciplines – physics over chemistry - resonates with the growing interest of both geographers and historians of science in the practice of the 'field sciences'.

Hence, the first principle of this manifesto: **that we abandon any sense of the hierarchy of the disciplines that places those sciences concerned with the study of the most general or abstract phenomena above those that are concerned with concrete situations in the field.**

To be clear, by the term chemical geography, I am not referring just to chemistry or to physical geography or biogeography, but precisely all those non-reductive practices that are concerned with the presence of chemicals 'in the field'.

A second reason why chemistry is neglected, in comparison to the biosciences, is that chemistry is thought to lack an obvious connection to life, the living or the 'vital'. The philosopher Henri Bergson, in particular, criticized what he viewed as the tendency of both physicists and chemists to ignore the creativity or vitality of living forms. In this

light, an interest in chemicals and chemistry is marginal to the interests of social scientists and philosophers concerned with the politics of life, whether they have drawn inspiration from Bergson or, more recently, the philosophy of Deleuze and Guattari. Although the concern with the vital has been extraordinarily generative, social scientists have been much less interested in what may be thought of as the merely functional, reductive, and industrial concerns of chemists.

But perhaps there is a further third reason for the neglect of chemistry and chemicals relates to the identity of geography. This is a legacy of the 19th century view, held perhaps by Mackinder, that geography should be primarily concerned with the physical landscape of the earth, as well as the societies that inhabit this landscape. In the division of the discipline between human and physical geography, chemicals are an absent presence. This absence anticipates the idea of the Anthropocene, in which the presence of chemicals is made explicit.

SECTION 4: Reflections on fieldwork and chemicals

My own interest in the geography of chemicals goes back 20 years. I retrospectively reconstruct this today as an ongoing interest in chemistry, which it wasn't at the time. In the late 1990s I was working at Goldsmiths and used to drive past a sign on the Old Kent Road, sometimes slowly in a traffic jam, which said you 'are now entering an air quality monitoring zone'. I'm reminded of this sign as I often come to UCL today on the 168 bus. The recorded announcer on the 168 tells passengers every now and then that its terminus is 'Old Kent Road Tesco'. The supermarket is situated near the old air quality monitoring zone. Twenty years ago this zone was funded by the European Union, and marked by an EU flag sprayed on a metal sign. Remarkably, long before Brexit, this was the only EU flag that I routinely saw in London at that time.

This sign, an apparently minor manifestation of the presence of the EU in Britain, influenced my research. It encouraged me to write a book, *Political Machines*, which was about the EU. But instead of dwelling on the political machinations of Brussels or the European Parliament, the book focused on those rather mundane devices, such as air quality monitoring stations, that were at the vanguard of bringing the lessons of European government to the UK – and which are now being unlearned (Barry 2001).

Political scientists and geographers are naturally and rightly interested in the ways in which people are governed. But political geographers often forget that states and international organisations also attempt to govern the unruly behavior of molecules as well as people, and that's what I took the sign to report.

Since then, I have periodically and unexpectedly, through the course of my research, stumbled on both chemicals and chemical concepts.

I was once hired as a consultant by a corporation. The job was for a medium sized pharmaceutical firm, where I was asked to study how pharmaceutical chemists were using, or not using, computer-modeling techniques in their work. The firm was located on the outskirts of Boston and I remember six weeks of fieldwork staying in a large hotel next to a freeway; the kind of a location familiar to McCarthy's anthropologist or protagonists in the novels of JG Ballard.

I often participated with chemists in lab meetings. The meetings, fueled by plentiful supplies of doughnuts and pastries, generally happened on speaker phone in the late morning so that collaborators in both the UK and California could be involved. Two things struck me in these meetings as well as in the numerous interviews that I conducted with lab employees.

One observation was that molecules had multiple forms of existence as they circulated through different parts of the lab, in samples and archives, and in computer simulations. The molecules took different forms, anticipating the new forms they would take if they were to become subsequently drugs. Molecules themselves had a geography.

The second was that the pharmaceutical chemists routinely talked about *chemical space,* a term that I had never encountered before. The term didn't refer to the length of chemical bonds, or the structure of complex pharmaceutical molecules. It referred to the economic and legal as well as the chemical relations between the molecules (Barry 2005). The pharmaceutical company was interested, after all, in molecules that it could acquire as its own through intellectual property claims, which it could then sell on to other companies. It was the proximity or distance from similar molecules that were already owned by the company or other companies that mattered. The term chemical space is a

hybrid concept that cuts across the boundaries between nature and society. In this way, has some similarities to the concept of the 'reserve' used by oil and mining companies. The pharmaceutical chemist seeks to explore and extract resources from chemical space through intellectual property claims.

But are these – and many other - diverse encounters with chemical elements and concepts – from the Old Kent Road to Boston - no more than random events? Or is there an underlying project that bonds these encounters together? My contention in this lecture is that although I stumbled on chemicals, there are more general reasons why we (as social scientists) should be more interested in chemicals and chemistry than we are today.

SECTION 5: From geochemistry to chemical geography

Chemical geography is not, as I have said, a discipline or even an interdisciplinary field. The idea is meant to be performative; the idea is intended to give visibility and coherence to a series of tendencies that already exist, and catalyse others that might emerge. But why should geographers become more concerned with the location and distribution of chemicals in the field?

My answer is partly historical. One observation is that, in practice, the distributions and concentration of chemicals have played a key role in geoscientific field research since the 18th century. However, the idea of a discipline of geochemistry was not clearly established until the late 19th century. According to existing accounts of the discipline, CF Schönbein, Professor of Chemistry in Basel, first used the term in 1838. Subsequently Christoph Bischof, Professor of chemistry and technology at the University of Bonn, who published his *Lehrbuch der chemischen und physikalischen Geologie* in 1847-55 came to regard the earth as "a vast chemical laboratory".

By the 1920s the term geochemistry appears to have become widely used. The US geological survey, for example, published volumes on 'the data of geochemistry' from the early 1920s on, while Victor Goldschmidt published a nine volume series *Geochemische Verteilungsgesetze der Elemente* in 1923-37 and established what came to be called the 'Norwegian School of Geochemistry' in this period. In his monumental textbook on

Geochemistry, posthumously published by Oxford University Press in 1954, Goldschmidt defined Geochemistry as a field that was fundamentally concerned with the *Verteilung* [the distribution] of the elements:

Image: cover of Verteilungsgesetze der Elemente

> 'Modern geochemistry studies the distribution and amounts of chemical elements in the minerals, ores, rocks, soils, waters, and the atmosphere, and the circulation of elements in nature, on the basis of the properties of their atoms and ions…[it] also covers the abundance and distribution of the various isotopes or atomic species of elements, including the problems of nuclear frequency and stability in the universe' (Goldschmidt 1954: 1).

At the same time, geochemistry played a significant part in establishing what is now the dominant geoscientific notion that the earth should be understood as a system that was simultaneously *chemical, biological and energetic*, as well as geological. As the influential Ukrainian mineralogist and geochemist Vladimir Vernadsky argued: 'living matter expressed in mass, chemical composition, energy and character of space may be studied by geochemistry as well as rock formations and minerals and compared with them in its manifestation' Vernadsky published a text on geochemistry in Russian in 1924 that has since been cited as the precursor to recent accounts of the Earth-System and the Anthropocene.

My suggestion is that two interconnected shifts happened over the course of the twentieth century. One was the development of a series of diagnostic techniques that made it possible to determine molecular and isotopic concentrations with increasing precision. This is the function of a small enclave of our own Geography Department at UCL –the Bloomsbury Environmental Isotope Facility located in a basement of the Chemistry Department. The facility houses mass spectrometers that measure the ratios of stable isotopes in samples containing common elements like Oxygen, Nitrogen and Hydrogen. Isotope ratios become indices of both local and global transformations, in climate, temperature, and the circulation of water. Global changes become embodied in subatomic differences. I'll come later to consider how the chemical geography of isotopes point forward directly to geopolitics and to debates over the Anthropocene.

The invention of new methods of chemical measurement had implications not just for the field of geochemistry, but across the geo and environmental sciences and physical geography more broadly, including subfields that subsequently emerged such as hydrogeology, urban geochemistry, as well as aspects of health geography, environmental justice, political ecology and citizen science.

A second shift is that from the 1960s on one of the core concerns of chemical geographers became with the **environmental impact** of human activity as well as the distribution of resources. In this context, a range of elements and compounds including heavy metals, mercury, arsenic, ozone, methane, CO_2, sulphur oxide and plastics figure both as significant pollutants and as indicators of the relation between the 'natural' and the anthropogenic composition of the earth.

So what I've called chemical geography was able, in the post-war period, to be no longer concerned with the natural distribution of elements as it was for Goldschmidt in the 1920s and 30s. It progressively acquired an array of diagnostic instruments and, at the same time, came to address the distribution of elements and isotopes that are a consequence of the enormous growth of the petrochemical, mining and nuclear industries over the course of the 20th century. For some chemical geographers the earth became repository of anthropogenic pollution. Sediments could be taken, in part, to be *archives of contamination.* Likewise a growing number geographers and anthropologists who are taking interest in such things as landfills, industrial ruins, and nuclear waste depositories. A recent artist in residence at the UCL Department of Chemistry, Hilary Powell, for example, dwelt on the appearance and chemical transformation of things such as corrugated iron, bricks, plastics and asbestos in her explorations of ruined buildings in London. This efflorescence of work can also be seen as part of what I term chemical geography.

Second principle of chemical geography. Chemical geography **Relies on and generates archives that are material – recorded in sediments, buildings, plants, animals and bodies – as much as textual.**

We can place the recent explosion of interest in the ideas of the Anthropocene in this political and intellectual context. The Anthropocene marks the epoch – our current epoch - in which human activity has come to have a profound impact on the earth system – climate change, but much more besides. Humanity has become a 'geologic force'.

The invention of the idea of the Anthropocene is therefore an artifact of a complex and uneven political shift in the sciences: a shift from the chemical geography of colonialism, articulated by William Jackson Pope, to a politically contested field, in which the two shifts I've just described play a formative part, in which the earth has come to be a repository of 'archives of contamination'.

Image: the colonial Anthropocene or the chemical Anthropocene?

If chemical geography, in Pope's formulation, was closely associated with colonialism, fossil fuel production and mining, then the debate about the Anthropocene is also a debate about the entanglement of the sciences with the history of colonialism and its aftermarth. Such an investigation would necessarily involve an account of the relation between the history of empire and planetary history, including an interrogation of the consequences of the colonization of South America as my colleagues Simon Lewis and Mark Maslin have argued. But it would also entail an analysis of the critical importance of the petrochemical, mineral processing and nuclear industries in the chemical geography and geopolitics of the 20th and 21st centuries. The Anthropocene is an emergent effect of many intellectual and economic histories.

Third principle: The Chemical geography that I'm envisaging renders explicit and intervenes in the political and ethical debates that are already emerging in the natural and social sciences themselves [even if these debates are not, or not necessarily articulated in explicitly or conventionally political terms]

In effect the term chemical geography entails giving a collective name to something that already exists – namely the myriad debates in the natural, social sciences and the humanities- in relation to pharmaceuticals, agrochemicals, mining and corporate responsibility, recycling, the green and circular economy, and about the ethics of

intellectual property, which may not necessarily be couched in the language of politics, but are forms of political debate nonetheless. My student Irem Kok has, for example, traced the arguments in US Universities about the composition of chemicals involved in fracking and their likely effects.

A fourth principle follows. In what has already been called a post-truth world in which evidence can be simply denied, or manufactured, it is tempting to reassert again the ideal of objectivity against its systematic distortion. But as climate change scientists grasped some years ago, or should have grasped, the idea of objectivity offers a weak defence against critics. But chemical geographers don't assert their objectivity, but look towards gathering more evidence – social, scientific, experiential - in the field.

Fourth principle. Recognises that research may be politically important in so far as it cannot be explained away as politically or economically interested [and not because it is merely objective.]

SECTION 6: Manifesto

The term manifesto is often associated with twentieth century avant-gardes. Think of the manifestos of Futurism, constructivism, situationism and so on. In the social sciences, there are only a handful of manifestos that are widely known and read today.

One, of course, is Marx and Engels' *Communist Manifesto* and the second is the eminent feminist historian of science Donna Haraway's *Cyborg Manifesto: Science, Technology and Socialist Feminism in the Late Twentieth Century* as well her more recent companion species manifesto.

Both Marx and Engels' manifesto and Haraway's cyborg manifesto are reflections on history, technology and political change. Marx and Engels are preoccupied by the energies of steam power, the most visible index of the transformative powers of capitalism in the mid-19th century, while Haraway dwells on the entanglement of information technology and military power at the height of the cold war of the early 1980s. The cyborg of her manifesto is a radical figure, which, like the working class for

Marx and Engels, comes to subvert the political order – the distinctions between human and machines - of which it is a product.

As Haraway recognized, the limitation of many political manifestos is they are meant for humans only. But it is striking that while these manifestos have much to say about the relation between the natural and the artificial, and the entanglement of humans and machines, they have little to say about the molecular machinery of chemicals. It is as if the petrochemical, energy, and pharmaceutical industries – the machinery for the transformation of the natural into the artificial – didn't exist. Yet it is this machinery that is at the centre of a series of concerns today: with farming techniques and climate change, with pharmaceutical drugs, electronic goods, fracking, and green technology: in other words, with the environments we inhabit, and the environments that inhabit us.

Fifth principle. The project of chemical geography is not anti-chemical (any more than Marx and Engels were against steam power, or Haraway opposed to information technology). **Rather the idea of chemical geography is founded on the recognition that the chemical compositions of atmospheres, landscapes and bodies have become critical sites for politics, government, and everyday experience.**

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SECTION 7: Events

Neither of the manifestos of Marx and Engels and Haraway has much to say about events. Of course, Marx and Engels drew attention to the 'decisive moment', the event when the contradictions of capitalism will be realized, but say nothing particular about the form that this moment will take – or that it might indeed be a *process* rather than a moment, or that there might be many moments. The absence of an account of revolution in Marx drew criticism from twentieth century writers including, in particular, Gramsci, Arendt, and Guattari. Gramsci famously observed that political events always had multiple causes and took geographically and historically specific forms. Intriguingly, when writing about May 68, Deleuze and Guattari described it using a chemical metaphor: in terms of the opposition of the molar [the politics of the state and party] and the molecular [the politics of the event].

The term the Anthropocene designates an event - registers the idea that a shift is happening which, like the growth of capitalism, is dispersed and geographically uneven. But there is no single 'decisive moment' to these shifts. There is no revolutionary insurrection – so, in the absence of a clear 'decisive moments', decisive moment are invented by creating targets and limits and boundaries expressed in measures of parts per million of atmospheric CO2. But as others have argued, it is difficult to animate political change only with numbers, even if these numbers represent concentrations of chemicals in the atmosphere. Gramsci's cautions about the geographical specificity of events apply, but his analysis has to be complexified, because chemical substances and biological organisms are often involved in political events too. A manifesto for a chemical geography is a manifesto for the Anthropocene.

My own work has been preoccupied by events. But I've preferred to focus attention on more local events than the Anthropocene, although whether they are local or not is itself often in question and itself part of the event. Consider, for example, the work of the Institute for Geophysics in Tbilisi, which I visited most recently in 2015, and in particular the research of the Georgian hydrogeologist, George Melikadze.

Melikadze carried out a piece of what might be considered radical chemical geographical research. I am going to tell you the story briefly.

He demonstrated that both BP and the World Bank, and their environmentalist critics had misunderstood the risks of a leak from an oil pipeline that passes from Azerbaijan through Georgia. By measuring the ratio of heavy and light isotopes of Oxygen he argued that an oil leak would pass into the spring water of the Lesser Caucasus through underground aquifers rather than on the surface. Melikadze's discovery was not a minor one because, if he was proved right, and if a leak were to happen in the future, it could have major national repercussions nationally and internationally for the World Bank and BP.

Melikadze's project tells us a lot about the need to think the relation between chemical geography and geopolitics. First, events – such as leak from an oil pipeline – are generally anticipated in advance. They are recorded in documents and research projects and risk assessments that are part. They are like the risks of Brexit to Universities in that respect.

They do not just occur – they are constituted in advance of their occurrence, and the anticipation of the event forms part of the event to come. Second, events are open. We simply do not know what would happen if a leak in the pipeline occurred, and whether it would turn out to be a major environmental disaster or not; whether it turns out to be an event that matters, or is simply a 'non-event'. And third, an account of the causes of this event would have to address not just the geopolitics of states and international financial institutions and the operations of oil companies and the importance of Georgian nationalism, but also the unstable geomorphology of the Caucasus, and the hydrogeology of its spring water, and the dynamic interference of all of these processes.

As this story shows, while it is easy enough to keep the social sciences and the natural sciences separate, sedimented in faculties and inter and intra departmental divisions, this is not so easy in the world of events; in events such as this briefly encountered in the field.

In the midst of events, chemical substances and geopolitical relations come together in unexpected and unruly compounds. Events such as this are complex assemblages, with unanticipated consequences. The importance of events also points to a concern with specificity in space and time in chemical geography.

In conclusion. As these remarks suggest my current concerns point in two directions, which are related but distinct.

One is with the infrastructure and geopolitics of the chemical economy. I am currently interested in the construction of huge gas pipeline, the Trans-Adriatic pipeline, which is one element of a gas pipeline running from Azerbaijan to Puglia, in southern Italy. Pipelines and refineries have become critical elements of infrastructure – linking the concerns of chemical geography to geopolitics.

My second current concerns turn to chemicals themselves, and the locations they inhabit, and the forms that they take. In the city, this includes the chemical composition of metals, dusts air, batteries, and plastics. Chemical geography draws together all these concerns with the ways in which materials are transformed and circulated, and become

embedded in sediments, buildings and bodies, forging connections between materials and politics.

Conclusion

So to conclude,

The term chemical geography refers not just to chemistry or to physical geography or biogeography, but – performatively – to all those non-reductive practices that are concerned with the presence of chemicals 'in the field'.

In this light chemical geography:

1. Abandons any sense of the hierarchy of the disciplines that places those sciences concerned with the study of the most general or abstract phenomena above those that are concerned with concrete situations in the field**.**

2. Relies on and generates archives that are material – recorded in sediments, buildings, plants, animals and bodies – as much as textual.

3. Renders explicit, and brings into dialogue, the political and ethical debates that are already occurring in the natural and social sciences themselves.

4. Recognises that research may be politically important in so far as it cannot be explained away as politically or economically interested [and not because it is merely objective.]

5. Is founded on the recognition that the chemical compositions of atmospheres, landscapes and bodies have become critical sites for politics, government, and everyday experience.

6. Interrogates and intervenes in events, in which chemicals as well as humans play a formative part.