

SOCIAL METABOLISM AND ENVIRONMENTAL CONFLICTS

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Ecological economics, which views the economy as a metabolic system of materials and energy flows, has a long tradition which arose alongside and, as we will see, close to, that of historical materialism. Ecological economists do not see the environment as one more sector of the economy, in the sense of the economics of agriculture or the economics of transport; they see the economy as a subsystem embedded in the environment, a subsystem open to the entry of energy and materials, and to the exit of waste (e.g. carbon dioxide). This 'metabolic' perspective implies that capital accumulation does not take place by itself, and it is not only based on the exploitation of labour and technical change. Economic and population growth lead to increased use of materials and energy, and therefore to greater waste production. Because of unequal property rights, and inequalities of power and income among humans (both international and within each country), pollution burdens and access to natural resources are also unequally distributed.

Capitalism (or, in general, the industrial system) advances into commodity frontiers because it uses more materials and energy, therefore it produces more waste, undermining the conditions of livelihood and existence not only of future generations but also of contemporary peripheral peoples, who complain accordingly. Such movements for environmental justice cannot be subsumed under the conflict between capital and labour. They may become a strong force in favour of sustainability and eco-socialism, and also against market-fundamentalism, because conflicts over the use of the environment are expressed in many languages of valuation. For instance, we know that economic growth goes together with increased emissions of greenhouse gases. Some social actors see climate change as an 'externality', the (damage or abatement) costs of which can be calculated in economic terms and compared to the benefits of economic growth. Others will appeal instead to the livelihood and rights of local peoples and/or future generations, or to

the sacredness of nature, or to ecological and landscape values measured in their own units, or to the equal dignity of all humans when confronted by 'environmental racism'. Why should all evaluations of a given conflict (e.g. over gold or bauxite extraction in Peru or Orissa, over hydro-electrical dams in the North-East of India, over mangroves in Bangladesh or Honduras sacrificed to shrimp exports, or over the determination of an acceptable level of carbon dioxide emissions by the European Union), be reduced to a single dimension?¹ People who are poor, and whose health and lives are cheap, often appeal to non-monetary languages of valuation. It is only capitalism, with its fetishism of commodities (even fictitious commodities, as in the 'contingent valuation' methods of neoclassical environmental economics), that sees only one way to value the world. Ecological economics rejects such a simplification of complexity, favouring instead the acceptance of a plurality of incommensurable values. By rejecting money-reductionism in favour of value pluralism, ecological economics can contribute to the success of struggles over distribution. For instance, Via Campesina denies that modern agriculture really achieves productivity increases, pointing to its decreased efficiency of energy use, chemical pollution, loss of seed varieties, and loss of local cultures.²

INTELLECTUAL BACKGROUND

Contemporary authors working on social or industrial metabolism look at the economy in terms of energy and material flows.³ This 'metabolic' view of the economy has roots not in economics but in the work of nineteenth century natural scientists. It was not until the 1960s that a few dissident economists (Nicholas Georgescu-Roegen, Kenneth Boulding, K.W. Kapp, Herman Daly) began to look at the economy as a subsystem embedded in a physical system of materials and energy flows.

This approach, however, deserves to be taken as seriously by socialists today as it was by Marx himself. His interest in the relations between the economy and the environment, particularly as regards capitalist agriculture, was expressed in the use, in his own drafts after 1857-58, and in *Capital*, of the notion of 'metabolism' (*Stoffwechsel*) between the economy and Nature. Marx became so keen on the concept of metabolism that in a letter to his wife (21 June 1856), he wrote charmingly that what made him feel like a man was his love for her, and not his love for Moleschott's metabolism or for the proletariat.⁴ Marx was one generation younger than both Liebig (1803-73) and Boussingault (1802-87) who from 1840 onwards published their research on the cycles of plant nutrients (phosphorous, nitrogen, potassium) in the context of debates on decreasing agricultural yields. Their analyses

of the composition of guano, and of other manures and fertilizers used by farmers, laid the foundations for agricultural chemistry. New agricultural rotations and new fertilizers made it impossible to assume that in Britain the produce of the land would increase more slowly than the number of workers employed on it; at the time production was increasing while the number of agricultural labourers was undergoing an absolute decline.⁵ This was part of the reason why Marx was not worried about crises of subsistence. He attacked Malthus' belief in decreasing returns, and also Malthus' thesis that improving the situation of the poor was counterproductive because they would have more children. In February 1866 Marx wrote to Engels that Liebig's chemistry was more important than all the economists put together in order to dismiss the notion of decreasing returns in agriculture.⁶ Later, around 1900, there were debates on 'how many people could the Earth feed'.⁷ Some Marxists (e.g. Lenin) attacked not only Malthus but also late nineteenth century Neo-Malthusians, who were often radicals and feminists – e.g. Paul Robin and Emma Goldman.⁸

In his published writings, however, Marx did not consider energy flows, although the link between material metabolism (*Stoffwechsel*, exchanges of materials) and the flow of energy at the level of cells and organisms had been made in the 1840s. It was then also understood that agriculture meant changes in energy flows, and not only in the cycling of plants nutrients (J.R. Mayer, 1845, used '*Stoffwechsel*' to refer to energy flows).⁹ Materials could to some extent be recycled, but energy could not. Heat could be transformed into movement, and also movement into heat, but much energy was dissipated in the latter process. The theory of the direction of the flow of energy was developed after the Second Law of thermodynamics was established in 1850.

Marx and Engels were keen on new sources of energy. One example will suffice. Under discussion at the time was the question whether hydrogen could be a net source of energy, depending on how much energy was required by electrolysis. In April 1866 Marx wrote to Engels that a certain M. Rebour had found a way of separating oxygen from hydrogen in water for very little expense. One intriguing point arises from Engels' unwillingness to accept that the First and Second Laws of thermodynamics could apply together: the 'dialectics of Nature' failed him there. As Engels became aware of Clausius' concept of entropy, he wrote to Marx: 'In Germany the conversion of the natural forces, for instance, heat into mechanical energy, etc., has given rise to a very absurd theory – that the world is becoming steadily colder... and that, in the end, a moment will come when all life will be impossible... I am simply waiting for the moment when the clerics seize upon this theo-

ry...'.¹⁰ But Engels' dislike of the Second Law was not only motivated by its religious abuse. He thought (together with other contemporary authors) that ways would be found to re-use the heat irradiated into space.

Another interesting point is Engels' negative reaction, in letters to Marx written in 1882, to the work of S.A. Podolinsky.¹¹ Podolinsky had studied the law of entropy and the economic process, and he tried to convince Marx that this could be brought into the Marxist analysis. Politically he was not a Marxist but a Ukrainian federalist narodnik, and he complained of Marx's overbearing behaviour at the 1872 congress of the International, praising the anarchist James Guillaume. Nonetheless he saw his work on agricultural energetics as a contribution to Marxism. Writing to Marx in April 1880 he said: 'With particular impatience I wait for your opinion on my attempt to bring surplus labour and the current physical theories into harmony'. Podolinsky's analysis started out from the proposition that the Earth was receiving enormous quantities of energy from the sun, and would continue to do so for a very long time. All physical and biological phenomena were expressions of the transformations of energy. He was hoping (as he had written to Marx on 30 March 1880, when sending his work to him) to develop applications of energy flow accounting to different modes of production. He explained that plants assimilated energy, and animals fed on plants and degraded energy. This formed the *Kreislauf des Lebens*:

We have in front of us two parallel processes which together form the so-called circle of life. Plants have the property of accumulating solar energy, but animals, when they feed on vegetable substances, transform a part of this saved energy and dissipate this energy into space. If the quantity of energy accumulated by plants is greater than that dispersed by animals, then stocks of energy appear, for instance in the period when mineral coal was formed, during which vegetable life was preponderant over animal life. If, on the contrary, animal life were preponderant, the provision of energy would be quickly dispersed and animal life would have to go back to the limits determined by vegetable wealth. So, a certain equilibrium would have to be built between the accumulation and the dissipation of energy.¹²

Not only plants but also human labour had the virtue of retarding the dissipation of energy. Human labour achieved this by agriculture, although the work of a tailor, a shoemaker or a builder would also qualify as productive work, since they afforded 'protection against the dissipation of energy

into space'. The energy available for humankind came mainly from the sun. Podolinsky gave figures for the solar constant. He explained how coal and oil, wind energy and water power, were all transformations of solar energy. He mentioned tides as another possible energy source. He then began his analysis of agricultural energetics, remarking that only a tiny proportion of solar energy was assimilated by plants. Human labour, together with the work of animals directed by humans, was able to increase the availability of energy by agricultural activity.

Podolinsky went on to explain the capacity of the human organism to do work – otherwise 'it would be difficult to explain the accumulation of energy on the surface of the earth under the influence of labour'. Quoting from Hirn and Helmholtz, he concluded (correctly) that 'man has the capacity to transform one-fifth of the energy gained from food into muscular work', giving to this ratio the name of 'economic coefficient', and remarking that man was a more efficient transformer of energy than a steam engine. He then used a steam-engine metaphor to propose a general theoretical principle concerning the minimum natural conditions of human existence, from an energy point of view. He wrote that humanity was a 'perfect machine', in Sadi Carnot's sense: 'humanity is a machine that not only turns heat and other physical forces into work, but succeeds also in carrying out the inverse cycle, that is, it turns work into heat and other physical forces which are necessary to satisfy our needs, and, so to speak, with its own work turned into heat is able to heat its own boiler'.¹³ Taking into account that not everybody is able to work (children, old people), and that there are other energy needs apart from food, a proper discussion of the demographic question had to take into account the relation between the quantity of energy on earth and the quantity of people who live on it, and this was a more relevant view than the Malthusian prognosis.

Podolinsky interpreted capital accumulation not as increasing the produced means of production in financial terms, but as increasing the availability of energy (and of course also its dissipation). He emphasized the difference between using the flow of solar energy and the stock of coal energy. The task of labour was to increase the accumulation of solar energy on earth, rather than simply to transform energy already accumulated on earth into work, especially since work involving the use of coal was accompanied by a great dissipation of heat-energy into space. The energy productivity of a coalminer was much larger than that of a primitive farmer, but this energy surplus from coal was transitory. Podolinsky was not, however, pessimistic about the prospects for the economy. He was hopeful about the direct use of solar energy for industrial purposes. He could envisage that one day solar

energy would be used directly to make chemical syntheses of nutritive substances, by-passing agriculture.¹⁴

The link between the use of energy and the development of human culture, in the form of 'social energetics', became well established and debated in Europe around 1900. Some Marxist authors (Bogdanov, 1873-1928; Bukharin, 1888-1938) adopted this outlook, and their work has been seen as an anticipation of Bertalanffy's systems theory, which grew out of the links between thermodynamics and biology.¹⁵ There is, however, no Marxist historiography that provides quantitative studies of material and energy flows, emphasizing their highly unequal distribution.

OTTO NEURATH

In my 1987 book, *Ecological Economics*, the relationship between Marxism and ecological economics was discussed mainly by looking at Engels' negative reaction to Podolinsky's agricultural energetics. But it also looked at Otto Neurath's contribution to the Socialist Calculation debate of 1919 and the following years, already acknowledged by K. W. Kapp. Otto Neurath (1882-1945) was a famous analytical philosopher of the Vienna Circle; he was also an economist or economic historian, and a Marxist in at least two senses. First, in the Socialist Calculation debate he defended a democratically planned economy based on accounting in energy and material terms (*Naturalrechnung*), following Popper-Lynkeus' and Ballod-Atlanticus' quantitative, realistic 'utopias'. He introduced the idea of incommensurable values in the economy.¹⁶ Second, some years later, in the context of the Vienna Circle's project for an Encyclopedia of Unified Science, Neurath defended a dialectical view of history (although he did not like the word 'dialectics') as the putting together of the findings of the different sciences on concrete processes or events. The findings of one science with regard to a given particular process or event should not be contradicted by the assumptions or the findings of another science also included in the Encyclopedia. An attempt should be made to remove the contradiction. To use Edward Wilson's later word, 'consilience' should be the rule of the Encyclopedia.

To grasp the relevance of Otto Neurath one must realize that Hayek's strong critique of 'social engineering' was, as John O'Neill noted, directed not only against thinkers like Saint-Simon but also against the tradition, now called ecological economics, which attempts to understand the ways in which economic institutions and relations are embedded within the physical world and have real physical preconditions, and which is consequently critical of economic choices founded upon purely monetary valuation.¹⁷ While Hayek rudely dismissed Patrick Geddes, Wilhelm Ostwald, Lancelot Hog-

ben, Frederick Soddy and Lewis Mumford, his main targets were Neurath's *Naturalrechnung* and planning.

SOCIAL METABOLISM TODAY

The use of energy in the economy is more relevant than ever, as we contemplate the patterns of economic growth of India, China and other countries and their effects on oil and gas prices, the increased human use of biomass as fuel to the detriment of other species, the imminence of 'peak oil', the increased use of coal and its influence on the greenhouse effect, and the growth of nuclear power.¹⁸ At the global level the use of all sources of energy is increasing. The consumption of biomass energy (food, feedstock and fuel-wood), is estimated to have increased more than four-fold in the twentieth century, coal six-fold, and oil many times more. The notion of 'energy return on energy input' (EROI): that is, the energy cost of obtaining energy (in different systems: wind energy, tar sands, fuel-biomass, etc.), was applied to the economy by Charles Hall and other ecologists in the 1970s, raising questions about its economic implications.¹⁹

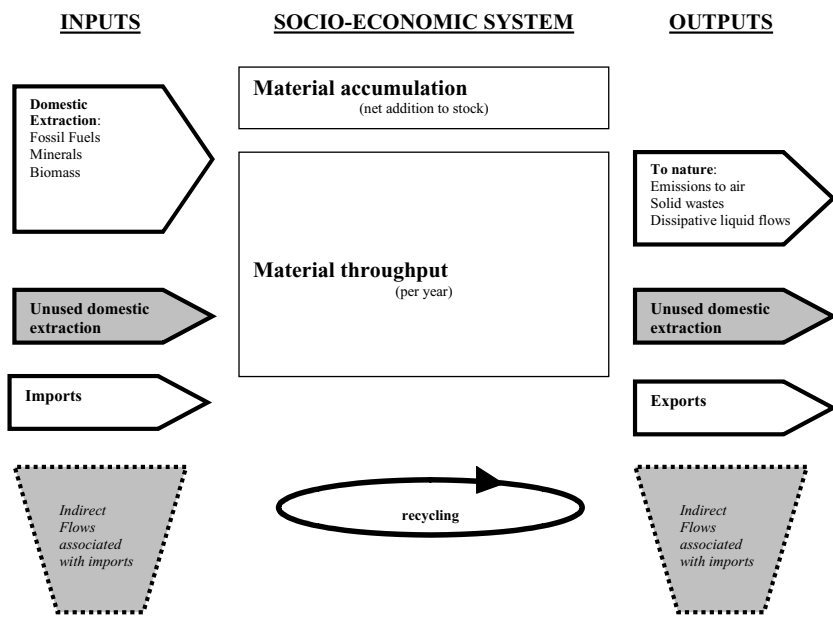
Since then research on material flows has made much progress. Eurostat statistics follow an agreed methodology developed through a debate in the 1990s.²⁰ In that framework, a complete balance for an economy can be carried out in the form of a Material Flow Analysis or MFA.²¹ Metabolic profiles are established in terms of energy flows as well as material flows. Fossil fuels and biomass will show up both in the material and energy statistics, but nuclear energy and hydroelectricity are not included in the material flows. Here we focus on material flows.

In the Eurostat methodology (Figure 1), material flows are classified into three main material groups (minerals, fossil fuels and biomass) and into four main categories (domestic extraction, imports, exports and waste). Waste is in part recycled outside markets by natural cycles. A small part is recycled by markets (some paper, metals). The net accumulation of materials can be calculated as the difference between what enters the system and what goes out.

This kind of analysis yields a very different picture of an economy from that presented by conventional or Marxist economics. Taking, for instance, the MFA of Spain between 1980 and 2000, the conclusion is reached that Spain's nice trend towards convergence of per capita income within the European Union is matched by its 'race to the top' in material metabolism.²³ The materials moved by the Spanish economy (i.e. DMI = domestic extraction plus direct material imports) increased by 85 per cent from 1980 to 2000, whereas GDP increased by 74 per cent. While in other European countries there has

been relative dematerialization (i.e. increased resource productivity), Spain followed a trend typical of developing economies. The growth of building

Figure 1: Economy-wide material balances (excluding air and water)²²



materials is remarkable, as is also the increase in energy-carrying materials, despite the decline of domestic coal extraction. The Spanish economy has become increasingly dependent on international trade. Imports are twice as large as exports in terms of weight: net imports have reached 3 tons per capita/year, displacing environmental loads elsewhere. Imports of biomass and particularly of oil and gas have increased. Also, metals that were domestically produced are now imported.

Taking all materials together (energy carriers, minerals, biomass), the European Union as a whole is importing about four times more tons than it is exporting, while Latin America appears to be exporting six times more tons than it imports.²⁴ Moreover, the South's exports carry heavier 'ecological rucksacks' than its imports, as shown by research on the energy and carbon-intensities of Brazil's trade – i.e. the energy dissipated, and the carbon dioxide produced, by each dollar of exports and imports – and by research on the 'environmental pollution terms of trade' for several metals.²⁵ Pengue has computed the hidden flows in the soybean trade of Argentina, in the form of loss of nutrients (this would have pleased Liebig and Marx), soil erosion, and

'virtual water'.²⁶ Will Argentina and Brazil now become large fuel-biomass exporters?

Pérez-Rincón gives figures for Colombia of 70 million tons of exports per year compared to 10 million tons of imports.²⁷ The periphery extracts and exports resources to satisfy the requirements of the centre. The theory of the deterioration of terms of trade in peripheral countries was formulated in parallel by Prebisch and Singer: an increased quantity of primary exports is needed to obtain the same amount of imported goods. Marxists pointed out that exports from poor countries were labour-intensive and produced by cheap labour, so there was also unequal exchange in terms of human labour.²⁸ Moreover, the centre-periphery division involves not only monetary exchanges but also physical exchanges in which Southern regions provide materials and energy so that the North can maintain and develop its socio-economic metabolism. In the United States oil imports are now over 10 mbd, i.e. 500 million tons or 2 tons per person per year. However, not all developing countries are net physical exporters: India and China are probably net importers (because of oil imports). Internally, some regions in India and China provide coal and other minerals. India exports much iron but also exports outsourced services. On the other hand, some rich countries with low populations (and high material and energy use per capita) are net resource-exporters (Canada, Australia), successfully following the path of Harold Innis' 'staples' theory of growth, contrary to much of Latin America, Africa and Indonesia. Whatever the historically changing positions of different countries or regions, the metabolic processes that maintain the world system's centres are underpinned by ecologically unequal exchange, deteriorating terms of trade for natural resources, exploitation of labour and, if necessary, by military force.

To summarize: economies today can be accurately described in terms of their metabolic profiles, as well as in terms of economic indicators such as growth of GDP, savings ratio, budget deficit as percentage of GDP, current account balance in the external sector, unemployment rate; or in terms of the social dimensions included in the Human Development Index (which, however, leads to a ranking not very different from that arrived at by GDP per capita). 'Metabolic profiles' of countries or regions are to be found in the statistics provided by MEFA (Material and Energy Flow Accounting) and by HANPP (human appropriation of net primary production of biomass).²⁹

Economic, social and physical indicators give non-equivalent descriptions.³⁰ For example, a given economy may be described in the following non-equivalent terms: it provides 240 GJ of energy per person/year, material flow amounts to 21 tons per person/year of which fossil fuels account for 6

tons. Of the material flows, 5 tons are imported, one ton is exported. Income per capita is 25,000 US\$. Of another economy, we may say that it provides only 25 GJ person/year, while its materials flow amounts to only 3.5 tons person/year. Income per capita is US\$1,200 (in purchasing power parity). Different classes of people could also be classified according to their metabolic profiles. We could study the different trends in the various components of the metabolic flows as the economy grows.

METABOLIC PROFILES AND ECOLOGICAL CONFLICTS

It is in the context of such thinking that political ecology studies conflicts over access to natural resources and services, and the burdens of pollution or other environmental impacts. Externalities are not so much market failures as cost-shifting successes. There are links between each society's metabolic profile and conflicts at local, regional, national and global scales. If an economy were 'dematerializing' in an absolute sense (and not only, as in some countries, relative to GDP), then many such conflicts would be less pervasive and intense. Ecological conflicts are classified here according to the points in the 'commodity chains' where they occur. Given space limits, only a few examples are cited.

Conflicts over the extraction of materials and energy:

1. Mining and Oil extraction conflicts. Complaints about mines and smelters because of water and air pollution, and land occupation by open-cast mining and slag. Many such conflicts have long histories (e.g. Ashio in Japan or Rio Tinto in Southern Spain around 1900). Likewise conflicts over oil and gas extraction. (Networks active in 2006: Mines and Communities / Oilwatch). For instance, in the growing economy of India, there are disputes over the mining of coal, iron ore, uranium, bauxite, mainly in Orissa and Jharkhand, by national public or private companies or by transnational companies (e.g. the Alcan and Vedanta projects in Orissa).³¹ There are conflicts over building materials, including some involving the deaths of officials who try to stop quarrying of sand by 'sand mafias' in Tamil Nadu.³²

2. Biopiracy. The appropriation of genetic resources ('wild' or agricultural) without adequate payment or recognition of peasant or indigenous knowledge and/or ownership (including the extreme case of the Human Genome project). The term 'biopiracy' was introduced by Pat Mooney, of Rural Advancement Foundation International (RAFI), in 1993. The fact is old; the new name reveals a new sense of injustice.

3. Land Degradation. Soil erosion caused by unequal land distribution, or by pressure of export production. For instance, in some areas of Ecuador, poor peasants farm the mountain slopes while the valley bottoms are used for flowers for export. The crucial distinction between pressure of population and pressure of production on the sustainable use of land was first made by Blaikie and Brookfield in 1987.³³

4. Plantations are not forests.³⁴ All over the world complaints are made against eucalyptus, pine, acacia plantations for wood or paper pulp or for cellulose production (often exported).³⁵ There is a clear link between export flows of biomass and the growth of such conflicts (e.g. the conflict on the Spanish ENCE cellulose plants in Uruguay in 2005).

5. Mangroves vs. shrimp. The movement to preserve mangroves for livelihood against the shrimp export industry, in Thailand, Honduras, Ecuador, Brazil, India, Philippines, Bangladesh, Sri Lanka, Indonesia.³⁶

6. National / local fishing rights. Other forms of use of biomass give rise to other conflicts. Conflicts over fishing are both national and local. National conflicts lead to attempts to stop open access depredation by imposing exclusive fishing areas, as in Peru, Ecuador and Chile since the 1940s. The language here is public international law. Struggles also occur to defend (or establish) local communitarian fishing rights against industrial fishing (as in coastal India, or the lower Amazon).

Conflicts over transport, waste and pollution:

7. Complaints over oil spills from tankers or pipelines, over new motorways, harbours and airports, over electricity lines, or over 'hidrovías' (in Paraguay-Paraná); e.g., the Sethusamundram Ship Canal Project between Tamil Nadu and Sri Lanka that will shorten navigation time between the east and west coasts of India, but constitutes a threat to the local fisheries because of dredging. Physical indicators for transport (tons/km) grow faster than GDP, and faster than the material and energy throughput in the economy. Another case in point is the protest in Val di Susa in late 2005 against a new train line from Turin to Lyon (part of a wider European network) that would destroy a mountain landscape.

8. Toxic struggles. A name given in the US to struggles against risks from heavy metals or dioxins.³⁷ It describes also older cases in other countries, such as the Minamata mercury poisoning in Kumamoto Prefecture in Japan, caused by the chemical manufacturer Chisso Corporation in the 1950s and 1960s; complaints are still being made today.

9. Waste dumping. The ship-breaking yards at Alang (Gujarat) have a devastating environmental impact, a situation highlighted by the debate about a toxic Danish ship sent there in 2005, and again in February 2006 when Greenpeace won a court case in Paris forcing the aircraft carrier *Clemenceau* to come back to Europe for dismantling. Greenpeace had coined the term 'Toxic Imperialism' in 1988 to refer to waste dumping in poorer countries, the 'thousands of tonnes of electronic and electrical waste (e-waste)...being illegally exported every year...to developing Asian countries, including India, Pakistan, and China', a trade described by the New Delhi organization Toxic Links as 'absolutely illegal and against the spirit of the Basel Convention'.³⁸

10. Transboundary pollution. This was a term applied in the 1970s and 1980s mainly to sulphur dioxide crossing borders in Europe, and producing acid rain; likewise from areas in central USA to New England, and from China to Japan.

11. Consumers' and citizens' safety. Struggles over the definition and the burden of unknown risks from new technologies (nuclear, GMO, etc.), which also affect producers (e.g. agro-toxics). Some conflicts are new (BSE, or 'mad cow disease'), others are old. Conflicts have arisen when regulatory authorities have failed to apply what is now called the 'precautionary principle'.³⁹ In China and India, the debate on nuclear safety will perhaps grow, given the growth of nuclear power.⁴⁰ Ulrich Beck focused on surprises (Chernobyl) more than on older technological conflicts (asbestos, DDT, CFC) or on well-known trends of metabolic flows (e.g. increased carbon dioxide emissions).⁴¹

12. Corporate accountability. When transnational corporations are involved, demands for 'corporate accountability' arise, e.g. claims under the Alien Tort Claims Act (ATCA) for compensation for damage caused in poor countries by Chevron-Texaco, Freeport-McMoRan Copper & Gold Inc., Southern Peru Copper Corporation, Dow Chemical and other companies. Another instance: the Indonesian authorities laid criminal charges against the world's biggest gold producer, the Newmont Mining Corporation, for disposing poisonous material into Buyat Bay in Sulawesi, damaging the inhabitants' health.⁴² A similar case was settled out of court in 2004, when Unocal agreed to pay compensation in another ATCA case in California brought by Myanmar (Burma) villagers and Earth Rights International, concerning the Yadana gas pipeline to Thailand. Lack of corporate accountability is also at issue in the Bhopal case from 1984 to today.

13. Equal rights to carbon sinks. This refers to the proposal that there should be equal per capita use of the oceans, new vegetation, soils and atmosphere as sinks or temporary reservoirs for carbon dioxide.⁴³ Unequal emissions of carbon dioxide have given rise to a 'carbon debt', as Andrew Simms calls it.⁴⁴

OTHER VOCABULARIES FOR ECOLOGICAL CONFLICTS

Claims for repayment of the 'ecological debt' owed by the North to the South bring together the 'carbon debt', i.e. damage done by rich countries through past and present excessive per capita emissions of carbon dioxide, and claims arising from biopiracy and ecologically unequal exchange. A contrast is also made between 'ecosystem peoples', who live off their own resources, and 'ecological trespassers' who live off the resources of other territories and peoples. This idea, proposed by Raymond Fredric Dasmann, was applied in India by M. Gadgil and R. Guha who identified three categories of people: 'omnivorous peoples', 'ecosystem peoples' and 'ecological refugees'.⁴⁵ 'Ecological footprint' is another term used in the context of international inequalities. The '*ecological footprint*' adds up the per capita use of food and other biomass, plus fossil fuels, plus the built environment, and translates it all into space. It has much merit as a communication device, and thrives politically, but it contains information that largely duplicates the energy (food, biomass and fossil fuels) statistics. Its success is due to its presentation of the issues in attractive spatial terms.⁴⁶

Sometimes workers' struggles have had an ecological content, 'disguised' under different headings. For instance workers' actions for occupational health and safety are struggles (in the framework of collective bargaining or outside it) directly against capitalists to prevent damage in mines, plantations or factories (they are, so to speak, 'red' outside and 'green' inside). Something similar is true of urban activism for clean air, green spaces, sanitation, cyclists' and pedestrian rights. The actors (and the analysts) in such urban ecological conflicts have only recently learned an explicitly environmental vocabulary. Ecological conflicts also give rise to what Bina Agarwal called 'environmental feminism', meaning the environmental activism of women, motivated by their social situation.⁴⁷ The idiom of such struggles is not necessarily that of feminism and/or environmentalism. The 'environmentalism of the poor' describes social struggles with an ecological content, today and in history, of the poor against the relatively rich, mainly but not exclusively in rural contexts. Famous examples in the 1970s and 1980s were the Chipko movement in India, and Chico Mendes' struggle in Brazil.⁴⁸

In resource extraction conflicts some actors deploy the language of 'indigenous environmentalism', that is, an appeal to territorial rights and ethnic

resistance. In some cases Convention 169 of the ILO is cited, for example against gold mining in Sipacapa, Guatemala, in 2005. In India, similarly, the Constitution is appealed to for the protection of adivasi peoples through the courts.⁴⁹ The language of human rights is also used in environmental conflicts, since livelihoods and lives may be threatened. In the United States waste disposal has given rise to the notion of 'environmental racism', meaning the disproportionate environmental load in areas mainly inhabited by African Americans, Latinos, Native Americans. 'Environmental Justice' is used to describe the movement against 'environmental racism', in South Africa and Brazil (and also in Scotland where some relatively poor communities suffer from open-cast coal mining or waste dumps).⁵⁰ Uncertainties on the causes of illness have given rise to 'popular epidemiology'. 'Environmental blackmail' is a term applied to situations where 'locally unacceptable land use' (LULU) is finally accepted as the only alternative to the local population staying without jobs.

Table 1 classifies conflicts according to the stage of the commodity chains where they occur, and their geographical scale (local, national/regional, global). Local movements profit by adding the strengths of global environmentalism to their own local resistance, in turn reinforcing regional or global networks.

IDENTITY POLITICS OR STRUCTURAL CONFLICTS?

The defence of indigenous groups against oil extraction or mining, or against large dams, logging or biopiracy, and the 'environmental justice' movements insofar as they fight against 'environmental racism', may be seen as expressions of 'identity politics'. This is mistaken, however, because the conflicts arise from structural causes and because there are cross-cultural similarities between environmental resistance movements. Thus, in the fights around the world for biomass and against the private appropriation of common property lands, eucalyptus or other undesired plantation trees are pulled out, and other locally useful trees are put in. In another instance, in July 1998, I took part as a sympathetic observer in an action by Greenpeace together with Fundecol (a local grassroots group of about 300 people in Muisne, Ecuador), in destroying at sunrise the crop of shrimps in an illegal pond by opening a hole in one wall, letting the water flow out, and replanting mangrove seedlings.⁵¹ The presence of the Rainbow Warrior's motley crew gave moral strength to the local group but both the destruction of that particular pond, and the replanting, were ideas proposed earlier by Fundecol. In December 2003 I travelled in Orissa and Tamil Nadu. In the conflict over shrimp farming in Chilika Lake, the traditional fishermen (200,000) were opposing a bill that

would give rights to other groups practicing 'improved traditional' methods of fishing. Behind the words 'improved traditional' (taken from the

Table 1: A tentative classification of some ecological distribution conflicts

Geographical scope ----- Stage	Local	National and Regional	Global
Extraction	E.g. resource conflicts in tribal areas, such as bauxite mining in Kashipur, Orissa.	Mangrove uprooting. Tree planting for export. Collapses of fisheries.	Worldwide search for minerals and fossil fuels, and bio-piracy by TNCs. Regulation of 'corporate accountability'.
Transport and Trade	Complaints on urban motorways because of noise, pollution, landscape loss.	Inter-basin water transport. Oil/gas pipelines (e.g. Burma to Thailand).	Oil spills at sea. Also, 'ecologically unequal exchange' because of large South to North material flows.
Waste and pollution, post-consumption	Conflicts on incinerators (dioxins), or on tropospheric ozone in urban areas.	Acid rain from sulphur dioxide. Nuclear waste, Yucca Mountain, Nevada, USA.	CO ₂ , CFC as causes of climate change/ozone layer destruction. Persistent organic pollutants (POPs) even in remote pristine areas. Claims for a 'carbon debt'.

Supreme Court's decision of 11 December 1996), they feared commercial prawn culture was lurking. After 10,000 fishermen of the Chilika Matysajivi Mahasangh had camped for a few days in Bhubaneswar the Orissa government withdrew the bill for public consultation.⁵² Further south, in Killai (Cuddalore District) in Tamil Nadu, where about 8,000 families made a living by fishing and agriculture, and where there were about 60 shrimp farms in 750 acres of cultivable *patta* and *poramboke* land, there was water pollution from the shrimp farms. As in Ecuador, so in Tamil Nadu, the proposal arose to break open the bunds of the shrimp farms. At midnight on 18 September, 2003 the shutters were opened. The following morning the police arrested

92 fishermen, including 32 women. The Campaign against the Shrimp Industries (CASI) declared that since 'all the arrested persons are victims of destructive shrimp industries, and the enforcement authorities [foreseen in the Supreme Court's decision of 1996] have failed to protect the resources of the people... it is the duty of the state to withdraw all the criminal proceedings'.⁵³

On the Pacific coast of South America, movements in defence of mangroves insist on their role as coastline defenders against recurrent Niños, and against the risk of rising sea levels due to the greenhouse effect. The same claim to be protecting the coastline (but this time against cyclones) is often made in Bangladesh, Thailand, India and Sri Lanka, particularly since the 2004 Tsunami. Similarly Oilwatch, born out of local conflicts between oil companies and local populations, has learnt to use 'greenhouse' arguments against oil extraction. Local groups complain against the impact of oil extraction (in Ecuador and Peru, as much as in the Niger Delta), pointing out also that more oil extraction means more carbon dioxide emissions. Stopping oil production at some wells (as happens sometimes), and a moratorium on oil extraction in fragile areas, would make a global contribution against climate change, deserving 'carbon credits'. Other conflicts seem to be prompted initially by global influences: witness the use of the language of 'biopiracy' in conflicts over property rights in *ayahuasca*, *uña de gato*, *sangre de drago* and *quinua*, and also in basmati rice, neem and turmeric, in both Latin America and India. It is therefore not convincing to see ecological conflicts as a manifestation of identity politics. It is rather the other way around: identity politics is one idiom in which environmental conflicts are expressed.

TOWARDS ECO-SOCIALISM

What, then, is the 'class nature' of environmental conflicts? James O'Connor in his 1988 theory of the 'second contradiction' of capitalism put the variety of actors in such conflicts centre-stage. While the 'first contradiction' of capitalism is between capital and labour, the 'second contradiction' is more widespread and cannot be subsumed under the first. This variety of actors (and languages of valuation) baffles believers in the doctrine that history should progress from assorted 'primitive rebels' to working class unions and political parties. Nevertheless, alternatives to the present economic system are being born out of such socio-environmental movements of resistance, pointing the way towards what one might call 'eco-socialism'.⁵⁴

NOTES

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- 10 21 March 1869, in Marx and Engels, *Lettres*.
- 11 Marx and Engels, *Lettres*. S.A. Podolinsky, 'Trud cheloveka i ego otnoshenie k raspredeleniiu energii', *Slovo*, 4/5, 1880, pp. 135-211. That is, human labour and its relations to the distribution of energy. (A Spanish translation was published in J. Martinez-Alier, ed., *Los principios de la Economía Ecológica*, Madrid: Argenteria-Visor, 1995). The German version with the title 'Menschliche Arbeit und Einheit der Kraft', appeared in *Die Neue Zeit*, Volume I, 1883, pp. 413-24, 449-57.
- 12 Author's translation of Podolinsky, 'Menschliche Arbeit und Einheit der Kraft',

- p. 420.
- 13 Ibid., p. 453.
 - 14 Podolinsky's work and life have a significance of their own, apart from his brief encounters with Marx and Engels. He is relevant for the history of ecological economics because he authored one of the first studies of the socio-metabolic flow of energy. Trained as a medical doctor and physiologist, he had a short life but left a strong trace in Ukrainian federalist politics (as a friend of Draho-manov) and also in the Narodnik movements against the Russian autocracy (as a young colleague of Piotr Lavrov though with close friends in the Narodnaya Volya group). His work on energy and the economy was praised by Vernadsky in *La Géochimie*, Paris: Alcan, 1924. Several authors (Felix Auerbach with his notion of *Ektropismus*, and John Joly) had explained life as a process which reversed or slowed down the dissipation of energy. Vernadsky then added a memorable phrase: Podolinsky had studied the energetics of life and tried to apply his findings to the study of the economy (pp. 334-5).
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- 21 Material Flow Analysis consists in counting in tons all the inputs to the economic system, separated into Biomass, Fossil Fuels, Building Materials, Other Materials (metals), counting also which part accumulates as stock and which part becomes a throughput in the economy and reappears as output (waste), also counted in tons. The largest part of the output is carbon dioxide. Eurostat publishes such balances for European Union countries.
 - 22 Accounting definitions:

Domestic Extraction: materials extracted in the national territory per year.

Direct Material Input (DMI): Domestic Extraction (DE) plus Direct Material Imports (I) ($DMI=DE+I$).

Domestic Material Consumption (DMC): DMI minus Direct Material Exports (E) ($DMC=DMI-E=DE+I-E$).

Water is excluded from MFA because its weight is of the order of one hundred times more than the material flows, and it would overshadow all trends. However, water use should be added to the metabolic profiles. The political ecology of water focuses on conflicts on dams such as in India the Narmada Bachao Andolan, also new conflicts in Pulichintala or in the North-East, and complaints against the 'interlinking of the rivers'. Also, conflicts on the use and pollution of aquifers (of which the Plachimada conflict in Kerala between farmers and the Coca-Cola company became world famous – there are many other such conflicts, often involving caste and gender inequalities). In Brazil there is an organized movement of *atingidos por barragens*. In 2005 a successful civic resistance movement led by a local bishop, stopped water transfer from the Sao Francisco river (see <http://www.irn.org>). The political ecology of water also studies the dumping of waste into water, or the energy and environmental impacts of new desalination projects, or the use and prices of water. There is also a new discussion on 'virtual water' (i.e. the water 'cost' of different products). Cf. A.Y. Hoekstra and P.Q. Hung, *Virtual Water Trade: A Quantification of Virtual Water Flows Between Nations in Relation to International Crop Trade*, Value of Water Research Report Series No. 11, Delft: UNESCO-IHE, 2002. See: <http://www.waterfootprint.org>.
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 - 29 The HANPP is not yet an official statistic. It is calculated in three steps. First, the potential net primary production (in the natural ecosystems of a given region or country), NPP, is calculated. Then we calculate the actual net primary production (normally, less than potential NPP, because of agricultural simplification, soil sealing), and then we calculate which part of actual NPP is used by humans and associate beings (cattle, etc.): this is the HANPP, meant to be an index of loss of biodiversity (because the higher the HANPP, the less biomass available for 'wild' species). This assumed relation is itself a topic for research. Results for Austria are presented in F. Krausmann et al., 'Land-Use Change and Socio-Economic Metabolism in Austria, Part I: Socio-Economic Driving Forces of Land-Use Change 1950-1995' and H. Haberl et al., 'Land-Use Change and Socio-Economic Metabolism in Austria, Part II: Land-Use Scenarios 1995-2020', both published in *Land Use Policy*, 20(1), 2003. Another research objective would be the modelling of the relations between MEFA and HANPP variables. For instance, intensive agriculture and use of fossil fuels has slightly decreased HANPP in Europe compared to the 1950s. An increase in the use of fossil fuels for cooking (kerosene or LPG) in India might lead to a slight decrease in HANPP, and therefore, to less pressure on wild biodiversity (so that kerosene and LPG would be good for the tigers). On the contrary, use of more fuel-biomass instead of fossil fuels, would reduce net emissions of carbon dioxide, but increase HANPP.
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 - 37 L.M. Gibbs, *Love Canal: My Story*, Albany: SUNY Press, 1981; R. Hofrichter, ed., *Toxic Struggles: The Theory and Practice of Environmental Justice*, foreword by Lois Gibbs, Philadelphia: New Society Publishers, 1993.
 - 38 See *Down to Earth*, 31 May 2005, pp. 16-17 and, for the source of the quotations, *The Hindu*, 18 December 2004.

- 39 See the report by the European Environment Agency, *Late Lessons from Early Warnings*, Environmental Issue Report No. 22, 2003 (available at reports.eea.eu.int). A new report with some more case studies is being prepared.
- 40 There is mistrust of breeder reactors both in Europe, where Creys-Malville was closed, and in Japan, where the Monju project in Fukui Prefecture was stopped by the courts. Meanwhile, the building start of the Kalpakkam breeder reactor near Pondicherry in 2005 was celebrated with such fanfare that it seems to be the main temple of modern India.
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- 52 Debrata Mohanty, 'Chilika Bill in Troubled Waters', *The Telegraph*, 22 December 2003.
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- 54 At the *Socialist Register* conference in Oxford in February 2006, where this paper was presented, this perspective was still characterized by some participants as 'romantic'. Romanticism is not a bad word. The Romantics criticized the socio-ecological horrors of the Industrial Revolution; they had a good nose for pollution in dark smelly factories and for the dispossession of resources from communities.