Chapter 6

MARXISM AND ECOLOGY

GUNNAR SKIRBEKK

Only recently has ecology become an object of study and concern, and
it has not yet made real inroads into politics, even if this winter’s oil
[1974–1975] crisis has begun to alert the public to ecology’s significance.
It must be said that the training of political leaders is more strongly
grounded in philosophy and political science than in biology, and further-
more that the established interests hinder any serious political concern
with ecology. The time has come to make politics and ecology interact. This
is what I would like to attempt concerning Marxism, and I believe this effort
will result in a mutual clarification of the two systems.

As a preliminary, ecology has to be situated in a long-term perspective.
If it is only a matter of eliminating the pollution of the Seine within five
years, the task is feasible; capitalism is capable of resolving limited ecologi-
cal problems. But what really is at issue is a global and enduring challenge
that neither capitalism nor Soviet socialism is prepared to face. I should
point out that I do not believe in a planetary “ecocatastrophe,” but rather
in an “ecocrisis” that will affect various classes and countries in various
forms at various times. If by “capitalism” we mean an economic system that
seeks to increase profit in an open market, this system will become
impossible as soon as, for ecological reasons, a future society demands
political control of the economy. In the long-term perspective, the problem
TOWARD AN ECOLOGICAL MARXISM

is therefore not "capitalism or socialism," but "socialism or fascism," that is, global democratic and egalitarian control, or global totalitarian, authoritarian, and probably racist control. The Soviet regime does not supply us with the model for this indispensable socialism, since it also exploits resources with no concern for ecology.

If these considerations are correct, what are their implications for Marxism?

Marx touched upon the problem of ecology:

Capitalist production collects the population together in great centers, and causes the urban population to achieve an ever-growing preponderance. This has two results. On the one hand it concentrates the historical motive power of society; on the other hand, it disturbs the metabolic interaction between man and the earth, i.e., it prevents the return to the soil of its constituent elements consumed by man in the form of food and clothing; hence it hinders the operation of the eternal natural condition for the lasting fertility of the soil... All progress in increasing the fertility of the soil for a given time is a progress towards ruining the more lasting sources of that fertility. The more a country proceeds from large-scale industry as the background of its development, as in the case of the United States, the more rapid is this process of destruction. Capitalist production, therefore, only develops the techniques and the degree of combination of the social process of production by simultaneously undermining the original sources of all wealth the soil and the worker.¹

We note, among other things, that Marx speaks of the Naturbedingung, the "natural condition."

However, for historical reasons, ecology as a research discipline and ecology as a crisis were almost unknown to Marx, even if some of the problems that are today called "ecological" were part of the proletarian misery that Marx knew and described so well: malnutrition, polluted air and water, noise, the degenerating environment, overpopulation. What is new is the universal character of these problems, and the fact that today certain elements of the bourgeoisie should be distressed about it; what is new above all is that the direction and seriousness of current developments represent a global danger of which Marx, in his time, was ignorant, and that his theory of the future development of capitalism did not allow him to foresee. For according to Marxian theory, capitalist exploitation of man and capitalist impoverishment of the earth would be overcome by a rational and international control that socialism would impose fairly quickly, since capitalism entails pauperization and results in crises of overproduction and revolution. For the moment, however, capitalism has more or less succeeded in resisting crises of overproduction by increasing the consumption of a large part of the masses in the advanced countries. Thus capitalist productivity has assumed dimensions unforeseen by Marx, while creating the current ecological crisis. Liberal capitalism, transformed into a planned capitalism, builds schools, hospitals, and social institutions. In collaboration with unions, capitalists pursue the development of production and consumption, which imposes a desire for rational planning of salaries and of state and private investments.

The growing ecocrisis of capitalist countries can apparently be analyzed in Marxian terms, but only in Marxian terms ecologically reframed: capitalism is moving toward a self-destructive crisis, not the one that was forecast, but toward an even more serious crisis, a universal ecocrisis. And this is why it is necessary to rethink certain elements of Marxism.

The conception of "natural condition" needs to be reevaluated. The infrastructure is comprised not only of the productive forces and the relationships of production, but also of the forces of nature. This implies that a reconciliation between the productive forces and the relationships of production, that is, a traditional socialist revolution, is not enough: there also must be a reconciliation between these two factors and the forces of nature; the socialist economy must be ecological.

For Marx the relationship of dialectical tension between the productive forces and the relationships of production constituted the motive force of history. The existing conditions of nature remained, for him, invariable conditions of production, that is, a constant, static element in social development. Natural resources are not known as limited, and they thus may form part of the static framework of production.

The existing conditions of nature will therefore have another position in the ecological perspective. Technoindustrial development has gradually created an opposition between the productive forces and the forces of nature, an opposition that will determine the future development of the world in a decisive fashion. Thus the opposition between the productive forces and the relationships of production can no longer be considered as the sole fundamental element of historical development.

The ecological perspective also plays a role in the theory of surplus value. Under the capitalist regime, value is created by productive workers. The price of commodities is composed of the cost of raw materials, of the reproduction of the forces of production, of administration and taxes, of

¹Translator's note. In a footnote, the author notes the difficulty of translating Bedingung (and its plural, Bedingungen) into French, opting (following J. J. Lentz) for "conditions existantes." In parentheses that follow "conditions existantes" in the body of the text, he remarks that this expression has been omitted from the Pléiade translation of Capital. For all of Skirbekk's subsequent references to this expression, I have maintained the singular (Bedingung) form that Marx uses in the passage cited above, and adopted Ben Fowkes's translation, "natural condition."
the cost of reproduction of the workers and their families in the current social conditions, and finally of surplus value, the profit which, through the reinvestments that competition makes necessary, implies capitalist accumulation and expansion. In this sense, surplus value represents the nucleus of capitalism, the principle of its exploitation and its objective injustice. Let me stress that value is created by labor, and only by labor. Natural resources are certainly necessary for labor, but resources do not create value. Resources represent a source of wealth (wealth that is not simply a natural fact, but one that depends upon the technological and scientific development of society). So far, so good. Nevertheless, in an extractive capitalist economy not only are workers exploited, but resources are destroyed. If you will, nature is impoverished through the destruction of resources as resources; a part of the natural resources is used without being restored, that is, without an equal quantity of wealth being returned to nature. Since resources are limited and the world population will continue to grow, this destructive extraction of limited natural wealth represents an impoverishment of future generations.

In order to do something constructive, one can try to put a price on resources, which today cost too little. As we know, this is a delicate problem, theoretically and practically. How can the loss of a beautiful site or of an animal species be evaluated, in relationship to a certain production of electricity or fuel? Finding a common criterion for incomparable phenomena is a theoretical dilemma. And what will be the result if we pay the complete ecoprice, which may mean the inability of some companies to withstand competition, and hence bankruptcies, dismissals, and an unemployment crisis. The market economy displaces its limits.

Let us use our imagination, and attempt to evaluate an ecological price. We shall add to the ordinary market price the cost, also in terms of market price, of cleaning up the pollution produced by each commodity, by putting the recyclable elements of each commodity back into circulation, and of restoring the ecosystems damaged by each commodity. And in the price, by our taxes, can be added the expenditures caused by use and decomposition of each commodity. This is feasible in a way. But, continuing our supposition, an ecoprice may more or less reduce profitability. In a first stage, the profit from a commodity is reduced, but the production of the commodity remains profitable. The ecoprice eliminates that profit. Production is healthy, from an ecological point of view, but this production can no longer function capitalistically, unless the same elimination of profit is simultaneously introduced into the whole system, thus eliminating competition. Then the ecoprice reduces salaries, perhaps below the level where workers can reproduce their labor power. If the production of a given commodity continues, thanks to nonecological prices and salaries, this means that not only do the capitalists exploit their workers, by claiming all the surplus value, and impoverish future generations through extraction of limited resources, but that even these workers impoverish future generations.

This hypothesis can be made more concrete by examples, among them cutting down and selling palm trees in an oasis. There is a limited number of trees, and one may either limit the cutting to what nature reproduces, possibly with the support of cultivation and replanting by man, or cut the trees down more rapidly than they grow back. In either case, the activity may be profitable, in terms of the market economy. But the activity is only ecologically healthy in those cases where the felling does not exceed the reproduction. And by calculating what will have to be added to the price to cover the labor necessary for the different degrees of replanting, we shall see different profitability in the ecological sense. In the cases where there is neither profit nor salaries, if the palm trees that have been cut down and sold have been replanted, and if the expenses of replanting have been added to the prices, both the capitalists and the proletarians live parasitically from the extraction of a limited resource (an extraction that is harmful to future generations).

This example is obviously abstract, a single activity having been isolated from the rest of a market economy. Here is another, more realistic example: The extraction of petroleum in Kuwait procures huge profits for the state and a considerable profit for the oil companies. At the same time, the salaries of the workers in the petroleum sector are several times higher than average salaries in the Near East. And labor in the oil firms is no harder, physically, than other kinds of labor in the region. Is it right to say that these worker create all these values, both the enormous profits and the high salaries? To the response that this is a situation where the prices are raised by monopolies, one may object that oil products are, on the contrary, too cheap, given what they would cost if the ecological damages were added to their prices. Let me put it this way: The Marxian theory of value founded upon labor is valid for the reproductive forms of production. But in an extractive form of production, value is transferred from resources to profits, which may then be called an extractive surplus profit. This extractive surplus profit can be so large that the entire production process, at all levels, can receive more value from it than the labor itself has created.

In this case, one must not say that every profit comes from the underpayment of the labor included in the product. According to the formula "profit equals sales price minus cost price," one can increase profit by raising the sales value, the price, or by lowering the cost price, through lower salaries, longer workdays, increased productivity, automatization, rationalization, through a monopoly on raw materials, through a decrease in social expenditures of various sorts, and through omission of expenditures for ecological restoration.

But who is "exploited" by this extractive surplus profit? Nature, and,
indirectly, future generations. Extractive surplus profit represents future pauperization. Oil companies, for example, are not only exempted from accounting for current ecological expenditures, they also omit future expenditures by depriving future generations of vital resources. (The idea of a future “exploitation” presupposes, among other things, that resources are limited and that the population is growing, not to mention that petroleum is a resource that can be transformed into a food for human beings that is rich in protein, something that will necessarily be lacking in the future.)

Here we can anticipate all sorts of objections. For example, the ecological price, stipulated on the market, is problematic, quite simply because it is a market price. One cannot blame workers for the inadequacies of capitalism, since even the workers’ consumption is a part of the capitalist economy. Despite all the false needs introduced by the system, the desire to obtain a higher standard of living through higher salaries is a good and fair thing, even when the supposedly higher standard of living, measured by gross national product, mainly represents a commercialization of activities that until now have not been recorded by the market, or even if today what we record as an apparent improvement of the standard of living represents activities introduced to compensate for environmental destruction. It is, therefore, not appropriate to conclude by preaching to so-called consumers, that is, the workers, that salaries and consumption should be reduced. Production itself implies consumption, and consumption implies production by the worker; if one wishes to change production and consumption, this cannot be done by isolated consumers who have been induced to cut down by moralistic pressure, but only by better organized producers: capitalists, or trade unionists, or labor parties.

However, the dilemma remains. When the economy is viewed in an ecological perspective, the need for an anticapitalist politics appears obvious, and such a politics must be linked to trade unionists and worker parties; but, at the same time, the organized struggle of classes for better salaries has become ecologically problematic. The struggle for better salaries is today insufficient, just as a planned economy is necessary but insufficient. What is needed is greater solidarity, geographically and historically; ecological knowledge must penetrate the masses, managers, technicians, trade unions, and political parties. This problem is essential for Marxist intellectuals and political militants, today.

In the same perspective, the time has come to reconsider some central conceptions of Marxism, particularly the theory of cyclical crisis, the theory of pauperization, and the theory of revolution. I will discuss these briefly. We notice a growing pauperization, especially in the less-developed countries, and various forms of relative impoverishment among the peoples of the rich countries. From this one can foresee the possibility of a certain polarization and an intensified class struggle. But the ecocrisis probably affects different groups in different ways, and at different times. Consequently, it will probably be very difficult to establish a common basis for global proletarian solidarity. Thus, the danger of a certain fascist tendency among well-paid workers in rich countries is a real danger. The concepts of crisis, impoverishment, and revolution are important concepts, which point to the imminent self-destruction of the capitalist system, but the content of these concepts needs to be rethought.

The concept of the working class also needs to be reexamined. Even if an unskilled worker in Detroit and a farmworker in India are both deprived of the means of production, and even if both of them produce surplus value for others, nonetheless, there are material reasons why the American worker and the Indian worker consider each other as adversaries rather than as comrades. To put it simply, one eats the bread that the other does not have the means to buy for himself. If the concept of “worker” is essentially defined by the relationships of production, the concept is inadequate in most of the political contexts where different groups of workers have very diverse possibilities for satisfying their needs. This definition is only adequate if proletarianization at the same time implies that all proletarians have more or less the same material situation—in any case, after a certain period of time. But in the ecological perspective, it is doubtful that this hypothesis will be valid: the poor in the Third World will never reach the level of consumption of a skilled worker in Europe or the United States.

Thus, if the existing conditions of nature are introduced into the infrastructure, the concept of the working class must also be defined in relation not only to the means of production, but also to the conditions of nature.

The moral conscience of the eighteenth-century bourgeoisie could tolerate the material inequality of the period because of their belief in progress: in the future, everyone will have a comfortable life. Up to this point, the socialist movement has regarded the current inequality between rich and poor workers in just this way: there has been a belief in progress and growth: in the future, in any case, when (and if) socialism triumphs, we shall all live well. But what if the future, socialist or not, implies the continuation of a growing differentiation between workers who live well and poorly nourished workers?

How can the workers in an underdeveloped country influence international capitalism? For example, can they use the strike as a weapon against the centers of capitalist decision making located abroad? Perhaps the oil policy of the Arabs last winter will serve as an example to underdeveloped countries that export raw materials: by uniting against the developed countries, they can win a greater control over their own resources and secure better prices for their products. For certain underdeveloped countries, this policy may prove fruitful. But it remains to be seen whether
this sort of policy will improve the lot of the masses in these countries, or only that of the elites. In this regard, the Arab example is not entirely convincing.

At an abstract level, everyone certainly has a common interest, that of avoiding an ecocatastrophe. This point of view is also important for the concept of class struggle. Before the threat of global destruction, all of us—capitalists or proletarians, rich or poor—have a common interest in survival. But the concrete meaning of this common interest is not the same for all.

If one does not seek to resolve the ecocrisis in an egalitarian way, but in an ethnocentric fashion, the struggle (even if it is not a class struggle in the orthodox sense) will probably intensify.

As for existing socialism itself, two essential changes will in any case be necessary for the classic model of the Soviet Union: a passage from economic growth, in the traditional sense, to ecological stability from extraction to reproduction, preferably by autonomous and self-supplied communities; and the passage from a pan-technological enthusiasm to a greater appreciation of agriculture relative to industry.

This change toward a productive and agricultural socialism implies changes in our conception of what is progressive and what is not. It also implies changing certain fundamental values and attitudes: a respectful, rather than an aggressive and exploitative, attitude toward the laws of nature; and an emphasis upon cultural, social, and political values, instead of an exaltation of economic growth in the traditional sense.

Virtues such as solidarity and discipline will be called for: neither selfishness nor ethnocentrism, but an egalitarian way of life; neither waste nor exploitation, but labor and prudence. And perhaps, in this perspective an "oikological" thinker, like Plato or Aristotle, may have something to teach us about the ideal life, both before and after the revolution.

These are a few essential themes of Marxist theory and practice that need to be rethought. Of course, it is not simply a matter of introducing a few more or less new concepts into the "Marxist system." It is a matter of concretely rethinking theory and practice, in regard to ecological problems, and this reexamination must be conducted with the participation of all the members of the Marxist movement, theoreticians and politically committed individuals, in different situations and places.

NOTE

The Greening of Marxism

Edited by Ted Benton
INTRODUCTION

TO THE DEMOCRACY
AND ECOLOGY SERIES

This book series titled "Democracy and Ecology" is a contribution to the debates on the future of the global environment and "free market economy" and the prospects of radical green and democratic movements in the world today. While some call the post-Cold War period the "end of history," others sense that we may be living at its beginning. These scholars and activists believe that the seemingly all-powerful and reified world of global capital is creating more economic, social, political, and ecological problems than the world's ruling and political classes are able to resolve.

There is a feeling that we are living through a general crisis, a turning point or divide that will create great dangers, and also opportunities for a nonexploitative, socially just, democratic ecological society. Many think that our species is learning how to regulate the relationship that we have with ourselves and the rest of nature in ways that defend ecological values and sensibilities, as well as right the exploitation and injustice that disfigure the present world order. Others are asking hard questions about what went wrong with the worlds that global capitalism and state socialism made, and about the kind of life that might be rebuilt from the wreckage of ecologically and socially bankrupt ways of working and living. The "Democracy and Ecology" series rehearse these and related questions, poses new ones, and tries to respond to them, if only tentatively and provisionally, because the stakes are so high, and since "time-honored slogans and time-worn formulae" have become part of the problem, not the solution.

JAMES O'CONNOR
Series Editor
INTRODUCTION
TO PART II

This part of the book brings together a small selection from a quickly growing literature that seeks to build from a critical revision of the Marxist classics towards an ecologically informed historical materialism. This selection begins with an important work of historical recovery: Arran Gare’s revelatory exploration of the early history of Soviet environmentalisms. As Enzensberger’s and Soper’s contributions, in Part I, acknowledge, the disastrous legacy of environmental destruction in the Soviet Union and Eastern Europe remains a profound obstacle to any red–green realignment. Gare’s study, which draws upon newly available sources, and in particular upon the monumental work of Douglas R. Weiner, shows that the tragedy goes even deeper than this. Between the Revolution of 1917 and the full consolidation of Stalinist power in the early 1930s, there flourished in the Soviet Union a diverse environmental movement, while Soviet ecologists led the world in the development of their science, and attempts were made to put Soviet agricultural and economic development on a sound ecological basis. Stalin’s victory over these forces set the Soviet Union on course for an ecologically and socially disastrous programme of centrally directed, forced industrialization. The science of ecology was “virtually suspended” for twenty years. Soviet science was put at the service of the drive for industrialization, paving the way for the doctrines of “proletarian science” and the notorious Lysenko episode. This, too, was a disaster both for the study of biological inheritance, and for Soviet agriculture.

So, there was no inner necessity in the subsequent antiecological
history of the Soviet Union. As Gare shows quite convincingly, the flourishing of ecological perspectives in the 1920s was facilitated by the revolution, while Stalin’s reversal of these developments involved a revival of prerevolutionary Russian nihilism. Sadly, not only was this period of Soviet history concealed from the Soviet people themselves, but its developments in linking ecology to socialist thought and practice remained undiscovered by later “Western” Marxists when they finally came to address these very problems from the 1960s onwards.

The remaining three selections in Part II represent but a small fragment of the creative work that has gone on since then. The debate has been an international one, with many contributions from Australasia to the Indian subcontinent, from North and South America, as well as from Western Europe. Advances have been made in four broad areas of work. First, the concepts of historical materialism have been revised and developed, with particular attention paid to the Marxian theory of the capitalist mode of production, so as to offer an explanatory account of the production of ecological degradation and crisis. Second, the socialist project has been redefined to give due weight to its ecological dimensions. This second task turns out to pose basic questions of a normative kind, some of which remain at issue between radical Greens and many ecologists. A third area of work, less developed so far than the others, concerns the development of a Marxian or socialist normative framework in environmental philosophy. Finally, any redefinition of the socialist project urgently calls to attention questions of agency and strategy. How should the currently existing environmental social movements, organizations, and parties be understood? What are the prospects for a realignment of left and green politics? What might be the relationships between any such realignment and other autonomous social movements such as feminism, anti-racism, gay and lesbian politics, and so on?

Gunnar Skirbekk’s pioneering essay, written in the wake of the oil crisis of 1974, clearly acknowledges the extent of the rethinking of Marxism that ecology makes necessary. Skirbekk argues for two crucial revisions in the Marxian theory of capitalist production if ecological crises and their consequences are to be comprehended. The first revision, which anticipates James O’Connor’s thesis concerning the “second contradiction of capitalism,” is that capitalism is, indeed, moving toward a self-destructive crisis. However, this is not the crisis resulting from the “opposition” between forces and relations of production postulated in Marx’s original theory. Rather, it is an “ecocrisis” resulting from opposition between the forces of production and the natural “conditions of production,” which Skirbekk also refers to as an opposition between the forces of production and the forces of nature. A clear requirement for theorizing this opposition is that the traditional Marxist concept of the “infrastructure” in any social formation has to be revised to include not only forces and relations, but also natural conditions of production. Skirbekk’s second revision involves a distinction between what he calls “reproductive production” and “extractive production.” In the case of the latter, surplus profits are made possible by not only discounting the costs of current ecological deterioration, but also by depriving future generations of the use of resources currently available. In these industries, therefore, it is not only labor that is exploited, but also nature and, indirectly, future generations.

Though his essay predates the enormous “growth industry” of environmental economics, Skirbekk provides a concise and cogent critique of its central strategy: conserving scarce resources and “internalizing” environmental externalities by including them in commodity prices through taxation or regulation. In Skirbekk’s view, this strategy is ultimately irreconcilable with capitalist accumulation because it threatens profitability, competition, and/or the reproduction of labor power. Ecologically sound production cannot, at the same time, be capitalist production. He also makes short work of the idea that moral pressure on and from consumers might suffice to resolve ecological problems on a capitalist basis. Clearly, both these environmental reform strategies have developed apace since Skirbekk’s article was written, and the issue of how far they might work, and with what consequences, remains very much open to debate. Nevertheless, Skirbekk’s arguments, especially his point about the incommensurability of environmental and other goods, remain pertinent.

On the question of redefining socialism, Skirbekk has relatively little to say. Nevertheless, his brief indications are worth developing. First, it follows from the inclusion of the natural conditions of production within the concept of the infrastructure that socialism as a mode of production must now be conceptualized as entailing a reconciliation not just between forces and relations of production, but also between these and the natural conditions of production, or “forces of nature.” This requires, as in the traditional conception of socialism, a planned, or political, direction of economic activity, but as the example of the Soviet Union shows, this is no guarantee of ecological soundness. What will be needed is a shift in the balance between industry and agriculture, and a shift from “extractive” to “productive” or “reproductive” activity.

These shifts, in turn, will require a very significant revision in the value system of “actually existing” socialist societies along two related dimensions. First, there will be a need to foster respect, in contrast to aggressive and exploitative, attitudes toward the laws of nature. Second, human fulfillment will itself have to be understood less in terms of technologically driven “progress” to higher material living standards, and more in terms of cultural, social, and political values. Like some thinkers in the anarchist tradition of social ecology, Skirbekk refers us back to the visions of the “good life” advocated by the classical Greek philosophers.

Finally, on agency and strategy, Skirbekk remains resolutely commit-
might suggest, since Leff's work transforms the classical Marxian concept of "forces of production" and so gives a radically new content to their "development." The two key features of his transformation are, first, the inclusion of ecological processes among the forces of production, and, second, the recognition of cultural resources as forces of production. The primary productivity of natural processes, ecosystems as "productive potential," should be subjected to a form of integrated, participatory management that selectively enhances their provision of use values.

This cuts against any view of ecodevelopment as a set of universalizing remedies, imposed from above, and centered on the conditions for the production and reproduction of capital. The new productive rationality that Leff proposes starts explicitly from the aims and requirements of local communities, and draws upon local material cultures which have themselves developed historically in relation to the specificity of local ecosystems. Technologies developed elsewhere could be incorporated into any such ecodevelopment strategy, but only on the basis of their appropriateness to local ecological and cultural conditions and processes.

Though this proposal is recognizably a socialist one, it does not seek to prescribe any specific model of development. Rather, the intention is to enable a proliferation of qualitatively different development paths, in accordance with differences in local communities and their environments. So, compared with more traditional Marxian views of agency and strategy, there are some clear departures. Moral and political values attributed to environmentalists and other "new social movements," such as welcome for cultural diversity and multiple identities, the rejection of centralized power, and universalizing projects, are endorsed by Leff. But there is, at the same time, a recognition that class interests are at stake, and that some form of unified political action will be needed to shift existing power relations. How far these strategic requirements can be consistently combined with the normative framework of decentralism and pluralism is yet to be explored and tested in practice.

Not only does Leff provide us with a rich and challenging approach to the key issues of Third World poverty within the context of environmental socialism, but he also demonstrates the indispensibility of historical materialism to this question. The concept of qualitatively different modes of production as specific combinations of cultural, technical, and ecological resources and relations enables us to see the question of "ecological limits" as both real and important, but at the same time as one that is relative to each specific mode of appropriation of nature. The implication of this is a view of the future as an open space of bounded possibilities, rather than as an increasingly self-destructive unilinear "development."

Leff's other important contribution is the avoidance of a certain "economism" in the concept of the economy itself, through his introduc-