PHILOSOPHY AND THE ENGINEER

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INTRODUCTION

It may seem unlikely now but engineering entered the groves of Academe through the philosopher's gate and not through the trades-men's entrance. The link, however, becomes more obvious when we realise that engineers and philosophers still have three major concerns in common. These are:

1. The need to understand the world about us.
2. The need for knowledge, where it comes from and what its limitations are.
3. The need to be able to differentiate between right and wrong in moral as well as technical terms.

The first two of these fall under the heading of Metaphysics and the last under Ethics.

METAPHYSICS

Metaphysics is normally defined as the systematic study of what really exists by rational means. Within this definition, existence is taken to mean that which is physically evident and cannot be analysed away. There are two classes of existence that are normally considered within the ambit of metaphysics, which are broadly as shown in Figure 1.
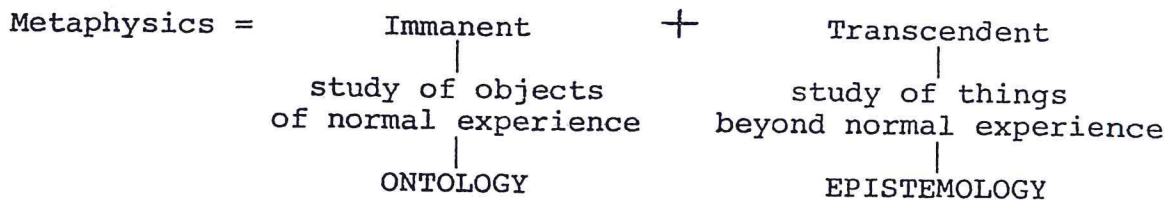
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Metaphysics =        Immanent         +        Transcendent
                        |                            |
                  study of objects            study of things
                 of normal experience      beyond normal experience
                        |                            |
                    ONTOLOGY                    EPISTEMOLOGY
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Figure 1.

ONTOLOGY

Ontology is the study of what really exists as opposed to what only appears to exist. In other words it is the study of those things which fall within one of the categories:

i) the concrete occupants of space and time
ii) states of mind (e.g. anger — which exists in time if not space).
iii) abstract entities or Universals (such as redness or fatherhood).

Ontology contains many different shades of belief from those who think all matter to be composed fundamentally from a single substance (perhaps energy) to those who feel that it only exists as a set of sense-data that measure and describe it and to those who believe that the world is merely an extension of the individual. If it is accepted that we can only rationalise things that we can communicate —if we do not have a word for it, it cannot exist— then it is easy to understand the sense-data idea. Quantum physics has demonstrated that we alter the world by observing it so that we really are intimately connected with our world, and it is by no means clear that unobserved events would take place. Physics is just as weired as philosophy, and indeed they are virtually identical at their extremities, as Gary Zukav's book the "Dancing Wu Li Masters" about physics, makes clear.

EPISTEMOLOGY

Epistemology is basically the study of knowledge, how it is defined, what kinds of knowledge there are, where it comes from and what its limits are. The definition of knowledge is not as straightforward as may appear at first, for there is clearly a distinction between knowing something to be true, believing something to be true and guessing correctly. Knowledge implies true belief but includes 'something more'. There is dispute about what that extra element is but it generally is felt to involve some form of justification for the belief that is held.

The different kinds of knowledge that exist may be distinguished under three broad headings, know-how, know-that and know-of.

KNOW-HOW

Know-how consists of knowledge of techniques for doing things, and as such is either empirically acquired or instinctive. Hence one can know how to drive a car, and know how to walk for example, which are similar types of knowledge but derive from different sources.

KNOW-THAT

Know-that includes much of the knowledge that we put to day-to-day use, and is normally split into two groupings, the Inductive and Deductive. Induction is the process of going from an observed effect to a suggested cause. In other words, from a series of specific observations we derive or infer a general theory which will explain their cause. Hence we gather data first then formulate an hypothesis.

However, Karl Popper felt strongly that no scientist would set about collecting data at random. If it is not at random then there must be an underlying logic, and that logic is based on an explanatory hypothesis. In other words, knowledge always begins with an idea, which is often intuitively formed. Once a general theory, built on this idea, has been formulated, the scientist sets about 'testing' it, and the basis of the testing is the attempt to find a means of falsifying rather than proving it. It must of course be falsifiable to be useful. Deduction therefore goes from the formulation of a general theory to specific consequences of that theory which are testable.

KNOW-OF

Know-of is a rather vague category altogether, as it can often be subsumed by the know-that category. Although there is little semantic difference between the statements "I know of the existence of the Ancient Greeks" and "I know that the Ancient Greeks existed", there is a qualitiative difference in the nature of the knowledge involved.

SOURCES

The sources of knowledge tend to be characteristic of the type of knowledge. Hence, in general, there are two main sources, intuition or empiricism. The relationship between learning and knowing is a problematic one, particularly as far as 'know-of' knowledge is concerned. At what stage does learning become belief, and what makes it into knowledge?

When we talk of sources, we are necessarily implying a belief in causality. We are presupposing that relationships exist between objects or events, and furthermore we are assuming that actions are purposive. Perhaps it is that without the underlying assumption of purpose, order and definite relationships, we would be unable to cope mentally with existence.

LIMITS

This of course leads on to the limits of knowledge. As Popper was at pains to stress, just because we have not yet disproved something does not mean that it will never be disproved. Is all knowledge therefore only temporary? How many times must our knowledge be tested before the probability becomes high enough that it can be taken as true? Is there anything that is ultimately unknowable, that is beyond our powers of perception and conception? Is theological belief part of knowledge? There are many questions that can be asked about the limits of knowledge, and indeed what role certainty has to play in knowledge.

SOME DEAD-ENDS

Although Metaphysics attempts to take a Positive approach by concentrating on what is (as opposed to what ought to be), it has two major stumbling blocks for the amateur philosopher. The first is the tendency for the development of ideas to degenerate into arguments over semantics. Because it depends upon rational arguments metaphysics is basically a set of propositions about existence. Most of the heated debate results from the tendency for the discussion to move

from the logical content of the propositions to the form of expression of the proposition, i.e. to do they mean precisely and unambiguously what they appear to say. This, unfortunately, is one of the worst failings of most philosophies and indeed philosophers.

The second major stumbling block in metaphysics is the tendency for the logical consequence to a line of argument to be a trivial one. Both of the favoured approaches have this shortcoming, Reductionism and Causality both tending to end up in the traps of Solipsism or Theology. Hence, everything exists because I exist and in relation to me, and will cease to exist when I die; everything else except me is merely a combination of sense-data. Or, on the other hand, no matter how much we split things up there will always be an unexplained residual which proves the intervention of a divine hand; and no matter how far back you take your chain of causes and effects, there will always be an unexplainable cause before the first cause in your chain — our Universe began with the Big Bang, but what began the Big Bang? — it must have been God.

CAUSALITY

Regardless of these problems, causality is of particular interest to engineers as a way of thought for two main reasons:
1. it enables us to prevent or produce particular events/effects which we cannot control by allowing us to identify causally related events/effects which we can control.
2. it enables us to explain why events/effects in the past occurred, and so should allow us to predict what will happen in the future under similar circumstances.

The ability to affect the present and the future by the selection and control of causally related events brings with it a serious responsibility. This responsibility is a duty; an obligation to consider not only what will happen but also what ought to happen. We have to call in our personal value judgement and consider what the 'right thing to do' would be. This takes us out of the field of metaphysics and into that of ethics.

ETHICS

The philosophy of ethics is basically normative, and is an examination of morality. The fundamental problem of ethics is the determination of what is good and right as opposed to bad and wrong, and in particular how we go about judging the rightness or wrongness of actions.

There are many different interpretations of right and wrong; almost as many, unfortunately, as there are different cultures. However, by-and-large all of these use one of three different bases for judgement. These are broadly as shown in Figure 2.

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                              Ethics
        ┌───────────────────────┼───────────────────────┐
    Formalism                Deontology               Teleology
        │                        │                        │
    Motivation                Conduct                  Outcome
        │                        │                        │
  Good or Bad              Good or Bad              Good or Bad
   Intentions              deed (cause)             result (effect)
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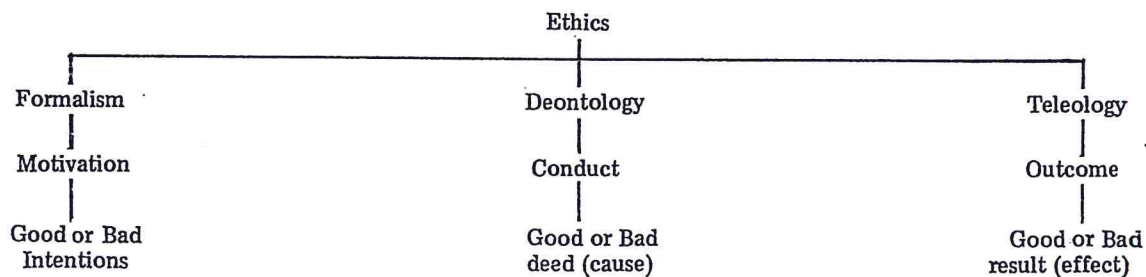
Figure 2.

Cultures differ in the emphasis they put on each of these criteria. Each can be justified in different contexts. It is possible to argue convincingly that actions have no objective moral value unless the motives are taken into account. Virtue and vice are judgements of the observer or of the actor and not of the deed itself or even of the outcome. It can equally well be argued however, that 'rightness' is a characteristic of an action just as colour is a characteristic of an object. Regardless of the outcome, if the action (cause) was right in the circumstances then it cannot be condemned. In this respect, a professional engineer cannot be judged to have acted wrongly if he followed the accepted procedures even if the structure he designs falls down. On the other hand, it is quite possible for a builder to contravene all normal conventions of good practice provided that the edifice he provides at the end performs as desired. In other words, the right outcome has defined the right actions — it does not matter what you do as long as it turns out alright. In engineering terms, we do seem to live by multiple standards.

The philosophy of ethics actually starts with a rather more fundamental question, one which is perhaps the ultimate problem in life and it is:

"What is the whole purpose of life (if there is one)?

Most philosophies tend to see a purpose of life, if not in terms of a grand plan, at least in terms of the pursuit of a 'good life'. From this two other problems naturally follow;

"What is a good life", and

"What is the correct conduct to obtain it?"

This latter question gives rise to a whole series of related questions, such as, 'Is there always a right way to act?' 'Is it ever right to act wrongly?' 'Who is the ultimate judge of an action?' These questions are raised by special circumstances which throw doubt on glib answers that we may otherwise give. The film "Sophie's Choice" illustrated this sort of dilemma; a mother having to choose between saving her son or her daughter from the Gestapo. It is a problem for which there is not a right answer in any objective sense.

In more general terms, our guide to conduct is that those actions which promote achievement of the 'good life' are morally right; immoral or bad actions defeat the objective. It is in defining what "good life" should be that the various religions of the world play their most important part. Most religions are based upon the teachings of the moral philosophers who were founding teachers, seers, sages, or prophets of those religions. Hence the schools of Confucius (seek self-perfection), Taoism (seek harmony with all things), Buddhism (seek to dispel all suffering) and Christianity (seek truly to love your fellow-man) are all examples of systems of belief based on the moral philosophy of a great teacher.

Clearly, different cultures may have different ethical standards, which may result in different choices being made in the same circumstances. Each must be considered equally capable of knowing right from wrong, even if these interpretations differ. The question for ethics hence becomes that of deciding objectively if there can be any absolute value which can determine how the perfect man would act in a perfect society. As it is, most people live their lives according to various codes of conduct, which are not mutually exclusive nor entirely consistent. Jeremy Bentham suggested using Utilitarian 'calculus' to guide one's actions. One should try to maximise the total benefit of one's actions whilst complying with the regulations of the appropriate 'sanctioning' agency. For most people there are four such agencies:

i) Political — the legal system represented by the law of that particular land.
ii) Moral — the opinion of one's peers (profession) or contemporaries.
iii) Religious — the moral code of the prevailing theology.
iv) Physical — pain and pleasure, whether physical or psychological.

In principle, only 'political' ethics are enforceable while the others only have powers of discipline over wrong-doers, not of punishment. Where punishment is deemed necessary, reference has to be made to the law of the land. Hence the professional institutions have no powers to punish, only to discipline or expel transgressors (similarly for the church and its 'ultimate weapon' — excommunication). Obviously, if any agency is to be vested with the powers to sanction its membership, it must have a set of rules (codes of ethics) which stipulate what is right and what is wrong. As it is impossible to write rules which will cover every situation clearly, it is often the case that guiding principles are used — such as the parables in the bible — which illustrate the correct moral stance without precisely stating a regulation.

Having skimmed fairly lightly over the top of some deep philosophical waters, it is appropriate to address now a little attention to engineering. To begin with, engineers who profess no interest in philosophical matters frighten me because it implies that they do not consciously question whether what they are doing is worthwhile. That means worthwhile in a broad social sense not simply in terms of the remuneration that they receive. The question has two parts, the first of which asks whether what they are doing ought to be done at all, and the second asks, if so, whether it ought to be done this way. All engineering briefs should be read as being conditional rather than as imperatives. In other words, one should presume that the conditional 'if' heads any client's brief — hence, one should read, for example, "If a Financial Complex is to be built in Port-of-Spain" where the documents say only "A Financial Complex is to be built in Port-of-Spain". If this part of the question can be answered positively, then the second part can be addressed and can largely be resolved by technical analysis in some form of value engineering.

Both parts of the question are in a normative form, in that they both contain the word 'ought'. This means that the

answers must be judgemental not simply technical, and hence that the philosophy of ethics is part and parcel of the most basic engineering decision-making. One of the obligations that is assumed on achieving professional status is that high ethical standards will be adopted. The duty that this imposes on the individual towards society, his client, his collegues and himself must not be distorted by commercial interests, nor by political or other forms of pressure. Further, it is a duty that does not confer the right of abstention. In Dante's words, "The hottest places in hell are reserved for those who, in a period of moral crisis, maintain their neutrality". That is no place for professional engineers to be.