
2.1 The Concept

The concept of a public good, in contrast to that of a private good, is used to designate commodities that by their very nature can be consumed simultaneously by any number of consumers, without any interference, such as the services of a landscape or a historical monument to the watchers. Such a concept naturally is idealized. In reality, the presence of a moderate number of other consumers usually increases the amenity of the site, by providing for service and social intercourse, whereas increasing the number of consumers beyond some threshold always is bound to cause pure nuisance. In terms of basic economics, it is implicit that if somebody were to produce a landscape or a historical monument, he could not expect to recover the production costs by selling it to any individual consumer, though all the interested consumers collectively might want to buy it. Implicit is also that nobody could invest in such a product and retail its consumption in bits at a charge to all the interested consumers. The very nature of the public good makes it almost impossible to exclude those who have not paid the fee from watching the scenery. Even if it were not entirely impossible, such an exclusion system might have to be so costly to run as to become impracticable. As a consequence, normal markets cannot provide for new production of such public goods, nor can they secure the maintenance of existing ones, and collective action becomes mandatory for their protection.

The examples of public goods that first come to mind, after the classics: provision of defence and law and order, belong either to the sphere of natural resources or to that of cultural objects. The reader may want to object that historical monuments were once produced; but they were produced in a different social setting as private goods for those who were then able to afford them.

2.2 Embodied Ideas

We should note that the degree to which cultural goods can be regarded as idealized public goods is related to the degree to which they are embodied in physical commodities.

Apart from specific embodiments, some cultural goods have the character of pure non-material ideas. Examples are: a scientific theorem, a poem, a novel, a drama, a symphony, an opera. Essentially, all culture, as something that gives nourishment for the mind, has this character.

Depending on the nature of the commodity, it will be easier or more difficult to separate the spiritual good from its material embodiment. For analytical purposes, it may be useful to distinguish between the specific embodiments and the ideas embodied. The former are often private goods, whereas the latter belong to the domain of public goods. There is, however, a tie between them. Even when an idea, in principle, can be disembodied, it may still be a delicate operation to initially free it from its physical embodiment.

2.2.1 Vivaldi's Oeuvre

The following story illustrates a particularly spectacular example. Few composers from the Baroque era are now better known than Antonio Vivaldi. In his lifetime, however, no more than five sets of sonatas and nine sets of concertos, such as *“L’Estro Armonico”*, *“La Starvaganza”*, and *“Il Cimento dell’Armonia et dell’Invenzione”*, the last containing “The Four Seasons”, had been published and so become available for posterity. One collection of chamber music, *“Il Pastor Fido”*, which had actually been composed by Nicolas Chédeville, had even misleadingly been printed in Vivaldi’s name in the eighteenth century, maybe to the end of promoting sales by the attribution to a famous master. See Fig. 2.1.

Vivaldi was also known to posterity through the six transcriptions of violin concertos by Bach for solo harpsichord. This only represented a fraction of his total oeuvre known today. The story of how most of it was rediscovered as late as in 1926–1930 by a zealous librarian in Turin would almost provide stuff for a novel.

During the Napoleonic Wars, the Chapel Royal of the Piedmontese court had stopped for a few nights in a small abbey on its refuge from Turin to Sardinia, hiding some of the music they had carried with them in its library.

It had been so well hidden, that it was not retrieved until 1926, when the monks needed some money for the restoration of the abbey, and therefore considered selling some of the manuscripts in their possession. There were in all 95 sensational volumes of music, among them 14 with music by Vivaldi.

This music could be traced back to a Count Durazzo, who had been Imperial Ambassador of the Habsburg Monarchy in Venice, and probably taken care of some



Fig. 2.1 This caricature is the only authenticated portrait of Venetian composer Antonio Vivaldi, now one of the most well-known composers of the eighteenth century. His oeuvre was known to posterity through a few contemporary publications of chamber music and through J. S. Bach's transcriptions of some of his violin concertos for solo harpsichord so that they could be played without having an orchestra at one's disposal. (Bach did the same with some music he liked by Alessandro Marcello, Telemann, and others.) The whole wealth of Vivaldi's music was, however, not recovered until 1930, and then by accident. The owner of some of the manuscripts considered it private property, and finally, at sale to a public library stated the absurd condition that the music be never published and never performed, a statement that, fortunately, is no longer respected. This in a nutshell catches the problems of public goods embodied in private property

of the music in Ospedale della Pietà, the home for orphans, where the late Vivaldi had been music teacher, and trained his girls to a virtuoso orchestra famous in all Europe.

Fortunately, the volumes found in the monastery were systematically organized, and it was not difficult to establish that about half the collection was missing. After some detective work it was suspected that the rest of it was in the possession of the last Durazzo, a somewhat feeble-minded marchese, who on one hand did not care what exactly he had in his library, on the other guarded his personal patrimony with jealousy, refusing everybody, even his servants, to come near the chaotic library. See Fig. 2.2.

It literally took 3 years of negotiations before, finally, the old marquess's confessor was able to arbitrate sale of the music. The marquess was infuriated when he learned that the monastery had sold their half of the collection, and this did not exactly facilitate the negotiations. One of the absurd conditions for the marchese's consent was that the music should never be published nor performed. In this way 300 concertos, 14 entire operas, and a lot of vocal and instrumental chamber music were



Fig. 2.2 Painting of a concert with the “orchestra of the ladies” by Francesco Guardi (1712–1793). This famous painting, currently in the Alte Pinakothek in Munich, displays a “reception for the Counts of the North”, with an orchestra of young ladies entertaining from the balcony. Antonio Vivaldi was priest by profession, and also a successful opera impresario. The church authorities were upset about his inability, due to asthma, of reading the mass, though he was known to be able to keep two mistresses. He was also music teacher in the “*Ospedale della Pietà*”; a school for orphans, where he trained the school girls to a virtuoso orchestra. It was famous in all Europe, and is known to posterity through the diaries of notable eighteenth century travellers to Venice. The church of this Ospedale still exists at the “Riva degli Schiavoni”, but the present edifice is a replacement of the original church where Vivaldi once worked

retrieved. The negotiations had to be conducted in secret in order to keep private curiosity hunters away until such substantial sponsorship had been secured that the Turin library could outbid everybody else.

Fortunately, two wealthy Italian industrialists wanted to commemorate their sons who had both died in childhood, so they contributed half the necessary funding each.

Social attitudes to which part of the cultural heritage can be regarded as private property and which cannot shift over time. Pictures, statues, and even architectural objects are generally regarded as legitimate private possessions, though most countries put constraints on their disposal. For instance, exportation of antiquities of a certain age is usually forbidden, and the reconstruction of historical buildings for modern use is subjected to severe control by antiquarian authorities.

Manuscripts too are regarded as legitimate private property, though keeping for oneself an original proof of Fermat's last theorem, or a seventh Brandenburg Concerto by Bach, modelled on his viol sonata in g-minor, the existence of which has been conjectured by some musicologists, would most likely be regarded as highly asocial behaviour, much more now than it was in 1926.

Once an idea has been initially liberated from its original embodiment it can live an independent life, but mostly the original is needed as a kind of "backup file" without which the public good may ultimately perish.

2.2.2 The Nature of Ideas

Those who very much dislike Platonic ideas, might be reluctant to concede reality to anything except the physically embodied cultural objects on one hand, and the individual experiences of beholding them on the other. It is, however, undeniable that there is something in common in the individual experiences of, say, a drama or a scientific theory, having an objective existence quite apart from the paper and the ink of the original manuscript.

One of the greatest philosophers of the twentieth century, Sir Karl Popper (Fig. 2.3), considered at length the issue of existence of ideas "the third world" in his *"Epistemology without a knowing subject"* and *"On the theory of the objective mind"*. He writes *"The main topic ... will be what I often call, for want of a better name, 'the third world'. To explain this expression I will point out that, without taking the word 'world' or 'universe' too seriously, we may distinguish the following three worlds or universes; first, the world of physical objects or of physical states; secondly, the world of states of consciousness, or of mental states ...; and thirdly the world of objective contents of thought, especially of scientific and poetic thoughts and of works of art. Thus what I call 'the third world' has admittedly much in common with Plato's theory of forms or ideas, ..., though my theory differs radically, in some decisive respects."*

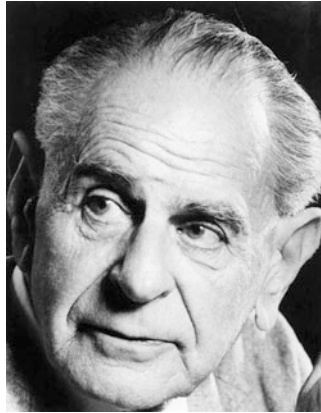


Fig. 2.3 Sir Karl Popper in his theory of the “third world” advocated the objective existence of ideas as something real, apart from the physical objects in which these were embodied, and from the individual experiences of them. His own description is as follows: *“The main topic . . . [is] what I often call, for want of a better name, ‘the third world’. To explain this expression I will point out that, without taking the word ‘world’ or ‘universe’ too seriously, we may distinguish the following three worlds or universes; first, the world of physical objects or of physical states; secondly, the world of states of consciousness, or of mental states . . .; and thirdly the world of objective contents of thought, especially of scientific and poetic thoughts and of works of art.”* He writes that though it has some similarity to Plato’s theory of ideas, it is essentially different, and has more in common with *“Bolzano’s theory of a universe of propositions in themselves”* and with *“Frege’s objective contents of thought”*. This was a study published in conference proceedings, and is not widely known. It was *“The Logic of Scientific Discovery”* (1959) that provided the basis for logical empiricism. To the general public Popper’s fame rests on the two volumes of *“The Open Society and its Enemies”* (1945), dealing with Plato, Hegel, and Marx as enemies providing ideas underlying the communist and fascist tyrannies of the time

Roger Penrose in his suggestive book *“The Emperor’s New Mind”*, manages to convince even the most incredulous reader that mathematical concepts, such as the Laplacian Operator or the Mandelbrot Set, are discovered rather than invented, in exactly the same way as is Mount Everest or a new elementary Particle. See Figs. 2.4 and 2.5.

A scientific theory, a literary work, or a piece of music can be used without touching the original, resting undisturbed in a library or an archive. In fact, it will only be necessary to return to the original manuscript on those relatively rare occasions when it is realized that its circulating contents have been distorted by too much editing to the purpose of filling in “missing” parts and correcting real or imagined “mistakes”.

Likewise, printed reproductions of paintings in an art history book can nowadays transmit an even better impression of the original than the original itself hung on the wall of some museum amidst crowds and photo flashes. Note how fast things have changed in this respect. The crowding in museums is a recent effect of mass tourism, and modern reproduction technique too is of so recent a date that Bernard Berenson

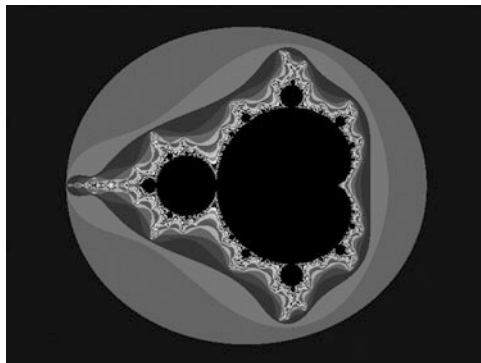


Fig. 2.4 The Mandelbrot set; invented or discovered? Roger Penrose claims that its discovery in no essential sense is different from the discovery of Mount Everest or of a new elementary particle. This mathematical object was discovered by Benoit B. Mandelbrot, and it shows if and how fast the iterated process of squaring a complex number with a complex constant added diverges to infinity. (In plain words, this means squaring the radius vector for a point in the plane and doubling its angle to the positive horizontal axis—further moving the resulting point by a fixed distance in a given direction). The picture is an example of the set of geometrical objects introduced by Mandelbrot which he called “*fractals*”. Non-smooth objects such as an irregular coastline, seeming to increase indefinitely in length the higher the resolution, had been considered as intriguing even before Mandelbrot, who managed to put it all in a comprehensive format that admitted objects of fractional dimension, for instance infinitely long curves, giving them a definite dimension. The concept could even comprise two-dimensional, area filling curves, such as those due to Peano and Hilbert, earlier considered as objects in the mathematical curiosity cabinet, but now understood as legitimate geometrical objects. The first picture of the intriguing Mandelbrot set was made at IBM in 1980. Since then more and more sophisticated software has been produced which can be run on any laptop, and displays amazing detail at every new level of magnification, among other an infinite number of miniature copies of the whole set itself. It is possible to explore the pictures to such detail that the original complete set becomes as large as the orbit of the planet Pluto

in his monumental picture books on Italian renaissance painting still refused to use illustrations in colour due to their inferior quality, though this was as late as in the years 1957–1963.

A solid copy of an antique statue, of the type the aristocracy used to adorn their houses and gardens with in times past, already, has a much stronger flavour of fake, and a miniature imitation of Piazza San Marco in some Disneyland borders on the verge of the ridiculous, in particular if put side by side with the Taj Mahal and Neuschwanstein. Nevertheless in a certain sense there even exists a disembodied idea of Venice, communicated in the numerous “*veduti*” by Canaletto, Guardi, Tiepolo and others, and in literary work by, for instance, Casanova, Ruskin, and Thomas Mann.



Fig. 2.5 Benoit B. Mandelbrot spent his scientific work in defining and studying fractals, objects of dimension different from the Euclidean point (0), curve (1), surface (2), and solid (3); curves that were infinitely long and surfaces that had infinite area, but that could yet be exactly defined in terms of fractional dimension. A huge literature grew out from Mandelbrot's ideas which captured the minds of the youth in particular. Fractals, though looking complex in Euclidean sense, could be considered as simple in the sense that the objects were created by very simple algorithms for maps repeated over and over. This fact gave the idea to procedures for storing existent images through finding the "recipes" for their creation, so called image compression, to the end of saving computer storage space, and was used to create artificial, though real looking landscapes, for instance in the film "*Jurassic Park*". Despite this enormous success, Mandelbrot (in a private conversation) once said to the present author; "*mathematicians do not consider me a real mathematician as I never proved a theorem—but my consolation is that Poincaré did not prove any either*"

2.3 Protection of Originals

In the eighteenth century, antique Roman culture penetrated throughout Europe. All those more or less accomplished marble copies of statues, and all the numerous prints, of which Piranesi's "*Vedute di Roma*" (Fig. 2.6) were the most successful, served as substitutes for the "grand tour" of actually visiting the classical sites. As substitutes they protected the originals, though the effect was not unambiguous.

The replicas could eventually also make people want to see the real thing, becoming preparations for a real tour, or, in terms of economics, complements rather than substitutes for it. Literary work too, such as Goethe's "*Mignon*" or Mme. de Staël's "*Corinne*", served to invoke a passion for the meridional.

More specific in purpose were all the "Baedekers" of those days, travel diaries by mostly famous authors: de Brosses (1739), "*Voyage en Italie*", von Goethe (1786), "*Italienische Reise*", Stendhal (1827), "*Promenades dans Rome*", Taine (1866), "*Voyage en Italie*". In the days of the grand tours of the wealthy the practical consequences, however, were negligible, in sharp contrast to those of mass tourism today.

To the extent that the artistic ideas have to be physically embodied, crowding around the originals is impossible to avoid. This is relevant in particular in the case of historical monuments. Embodied cultural commodities become similar to exhaustible natural resources, and special measures have to be taken to preserve



Fig. 2.6 Piranesi's engraving of Piazza Navona, located on the ancient racecourse Circo Agonale in Rome. In 1745 Giovanni Battista Piranesi published the 135 etchings of his famous work "*Vedute di Roma*" (Pictures of Rome), where the picturesque antique ruins of Rome in decay amidst the splendour of the new Baroque edifices were romanticized. Besides the engravings of the Fontana di Trevi and the Forum Romanum, this is probably the most well-known of the etchings. The work spread through Europe and became an appetizer for the "grand tour" to Italy. The dramatic touch with an extreme contrast between light and shade was even more pronounced in Piranesi's later almost science fiction like series of imaginary prison vaults, the "*Carcere d'Invenzione*"

them from being actually exhausted by consumption. The unregulated market does not pay any attention to the ideas of Florence or Venice, embodied in the physical cities, which can be literally worn down by unregulated consumption in tourism. In addition to physical deterioration, a historical town can also be economically damaged by tourism, through increasing living costs, and through diversion of the economic activities from what is useful for the permanent inhabitants, as demonstrated by the research of Gian-Franco Mossetto.

Venice is a particularly good example, where butcher's and baker's shops have literally been replaced by shops for glass and jewelry. As a consequence we notice such drastic decrease to about half of the permanent population, as was in fact witnessed the last decades, almost closing the city down between tourist seasons (Fig. 2.7).

Despite this Venice is in a unique and favourable position due to its location in the middle of its lagoon. Not only did this protect the city against foreign invasions for many centuries, until it was finally conquered by Napoleon. Still today its unique dual transportation system, by winding canals, and by narrow corridors for walking, interrupted every few steps by bridges, make it totally impossible for



Fig. 2.7 Picture of eighteenth century Piazza and Piazzetta San Marco in Venice painted by Canaletto, Antonio Canal (1698–1768). Canaletto was the most productive of the “vedutisti”, with an almost photographic style, very different from the more “impressionistic” painting by his contemporary Guardi. His pictures were favourite souvenirs for “grand tour” visitors. The Venetian townscape and civic life has been amply documented in pictures from Gentile Bellini and Vittore Carpaccio of the fifteenth century to the late eighteenth century vedutisti. In this picture the visitors are few as compared to any tourist snapshot of today and the stress and strain put on the city very modest, as compared to contemporary tourist invasions. In the eighteenth century, the authorities of the aging aristocratic republic encouraged tourist income, though they were watchful on citizens having any intercourse with the visiting foreigners. Many a noble senator made his way across the “ponte dei sospiri” or to the lead chambers on the slightest suspicion of such contacts. This ambiguity resembles that of today, though the motives were different. In the eighteenth century it was public security that was concerned in a state whose secret waterways had protected it against invasions for centuries, and continued to do so until the siege by Napoleon. Now it is tourist income versus wear and tear on the city that are on the scales

adaptation to any modern transportation system. Like no other city it is therefore effectively protected from cars. However, shipping and ruined agriculture, cause enough damage to the water balance, to an extent that even the general public is concerned by the “aqua alta” that step by step ruins the city.

2.3.1 The Marais

A unique example of a once magnificent city district which was ignored and left to decay for Centuries is provided by the Marais in Paris. It was fortunate that it was not reconstructed like other parts of the city, just ignored. This made it possible to undertake the very ambitious and costly restoration of the entire area undertaken around 1970 and continued for decades.

In the time of Henri IV and Richelieu, the Marais (literally the swamp) was the part of Paris where the nobility had built its magnificent city palaces. The centre of the area, the Place des Vosges today, or Place Royale, as it was then appropriately called, itself had been the obvious location for splendid Royal festivities, as illustrated in numerous contemporary engravings, such as the carousel given by Henri IV in 1612. See Fig. 2.8.

In the nineteenth century the whole area started to decay, palaces were rebuilt with added floors, and eventually become a slum in decay, where it was literally impossible to see for anybody but the specialists what had once been magnificent palaces. See Figs. 2.9 and 2.10. Around 1970 the Place de Vosgues itself looked rather shabby despite the remaining arcades. In the following decades a thorough restoration “*savegarde et mis en valeur de Paris*” of the entire area took place, and



Fig. 2.8 Festivities at Place des Vosgues in the time of Henri IV. Engraving by Claude Chastillon, “*Dessains des Pompes et magnificences du carousel faite en la Place Royale*” 1612. In Musée Nationale du Château du Pau



Fig. 2.9 Hotel de Saint Aignan in the Marais district in Paris, originally built as residence for the Duke of Saint Aignan, for some period location for the archives of the city of Paris, and currently museum. In the early twentieth century, the whole Marais area became a slum, and remained so until the 1970s. The duke's city palace was converted to a block of flats, with new storeys added, and the outline was totally changed as we see in next picture. The same held for other palaces in the area, and its centre, the Place de Vosges, where the arcades remained but the buildings themselves fell into a miserable condition

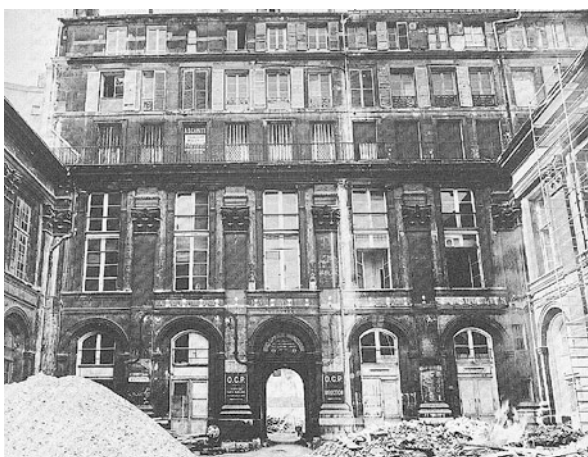


Fig. 2.10 In the time of Richelieu the Marais (literally the swamp), located around the Place des Vosges was the part of town where the nobility had built its city palaces, and the Place de Vosges itself had been the obvious location for Royal festivities, as illustrated in contemporary engravings. Gradually the whole area became a slum, the palaces being rebuilt so that they were no longer recognizable for anybody but the experts. In the 1970s a large scale reconstruction of the whole area took place, and it can now be seen in most of its former splendour The picture shows what the Hotel de Saint Aignan looked like before restoration

it can again be seen in all its original splendour. It is even good to have ample photographic documentation of its period of decay so that it is now possible to see what the area looked like.

2.3.2 Paris and Vienna

A complete transformation of Paris during Napoleon III, was worked out by his city planner baron Georges-Eugène Haussmann, who built all these straight boulevards, cutting through the medieval criss cross of old streets and houses. It has been argued that the reason was to keep riotous masses of people under control through facilitating the use of artillery, though this is by no means certain. True is, however, that this was the most merciless violence ever done to an old city. However, these boulevards are what the tourist now remembers most from Paris.

A less violent transformation was in Vienna, where it was the useless earlier city walls and moats that provided room for the magnificent ringroad, with its splendid neo-style showpieces for parliament, town hall, museums, and theatres, all tokens of the pride of a rising bourgeoisie in the aging Habsburg monarchy (Fig. 2.11).



Fig. 2.11 Part of the Ringstrasse in Vienna, completed in the 1880s on the former city walls and moats. The Parliament is seen in the picture. The ambiance also contained such showpieces as the City Hall, the University, the Burgtheater, the twin Museums of Fine Arts and of Natural History, and the Staatsoper. The splendour of all these neo-gothic, and neoclassical edifices are tokens of the pride of a rising wealthy bourgeoisie, and reduce the impact of the more modest palaces of the nobility in nearby Herrengasse, and even of the Hofburg itself. Inside the half-circle of the Ringstrasse, the Bezirk 1, and the Donaukanal, an old dictate by Maria Theresia prescribed that the buildings must not exceed a certain height. It is still respected and gives this rather vast city centre a cosy character not like any other European capital, where skyscrapers now tend to grow up as mushrooms

Even those transformations, which were once criticized for utterly bad taste, are now history, and uncompromising historicism would be an untenable idea.

What would we otherwise do with all the Cathedrals which may have been started in the thirteenth, fourteenth, or fifteenth centuries and not been finished until the nineteenth? John Ruskin who in his book “*Stones of Venice*”, only accepted the Gothic as genuine, would no doubt gladly have torn down all the Palladian Churches, and all the Baroque Palaces in Venice, but his opinion definitely was a very extreme one.

2.3.3 Piazza San Pietro

To take another example, consider San Pietro in Rome. Is only the centre of the building with Michelangelo’s dome genuine, or should we accept the transept facade adorned with Maderna’s contemporarily nicknamed “ass ears” of towers as well? And what about Bernini’s colonnade around the huge Piazza. See Fig. 2.12. After



Fig. 2.12 Another Piranesi engraving representing the Piazza San Pietro in Rome, including the Bernini colonnade, deliberately constructed so as to give an impression of an even greater depth than the actual from the entrance using decreasing height of the columns. As mentioned, the colonnade was earlier denounced as destroying the magnificence of the church which originally resided over a maze of tiny houses disorganized along narrow winding streets. Decidedly there is something new in this theatrical setup of the Baroque. This is in bright contrast to the High Renaissance interior of the church, which is so harmonious that you must actually know that the altar baldachin is 29 m high and the cupola 132, or see some people around to understand its huge proportions

all the church used to tower over a maze of narrow streets and tiny houses, which of course increased the overwhelming effect of the basilica.

Later exactly the same complaints were given against the construction of Via del Conciliazione. The broad avenue, leading up to the Bernini colonnade, would destroy the overwhelming impression of the Basilica, whose magnificence was now regarded as being enhanced by the colonnade. We obviously have to consider that a townscape can only survive provided it is continuously used for normal economic activity, and then we have to accept some compromises. Only traffic and transportation is a real danger, not only to historical environments, but to civilized city life at all. This problem is, however, not new.

In ancient Rome of the first Caesars people used to complain that it was not possible to sleep at night due to the constant noise of goods transport which, according to imperial command, had to be done during the nights when the streets were empty, as this was the only practical possibility of providing this huge city with the necessary provisions, and of removing the wastes. See Carcopino, *“La vie quotidienne a Rome à l’apogée de l’empire”*.

Fortunately, historical monuments are in this respect unique. Other cultural objects, such as scientific, literary or musical works, are not in the same danger of being worn out. Wear and exhaustion only apply to the original manuscripts, which, as we noted, can be left untouched despite ongoing consumption.

2.4 Performing Arts

It is true that scarcity and crowding can also occur when culture cannot be consumed without an intervening performance. Even though a play can be read by anyone, and a score for a symphony by trained people, the experience of reading is rather imperfect as compared to a live performance.

Such performances have limited audience capacity and thus become subject to the effects of crowding, unless they are broadcast, televised, video-taped, or recorded. The difference, in comparison to historical monuments, is that music or drama is never eroded by crowding. Temporarily, a piece of music or drama can, of course, seem to become eroded as an idea, by too frequent and too vulgar repetition, but this is a quite different operation, working on peoples minds rather than on the cultural objects themselves. Moreover, the exclusion principle is quite easy to apply at most performances.

Whenever pricing, without recourse to some kind of rationing, does not establish equilibrium of supply and demand, this is due to the fact that music and drama are treated as merit wants and therefore subsidized.

2.5 Property Rights

The cultural goods which are not embodied in concrete physical objects present different problems, which actually increase with the ease with which the spiritual ideas can be disembodied from the original sources.

This stems from the fact that they are difficult to produce but easy to reproduce. It applies in particular for scientific achievements. A mathematical theorem, once needing the genius of an Euler or a Gauss for discovery and proof, can later be reproved by every college student. As we will see, there has been a lot of theft of ideas over the ages, and a tendency to keep disembodied ideas in secrecy. In the seventeenth and eighteenth centuries musical ideas were reused not only by the proper composers themselves, but by colleagues as well, sometimes without any indication of origin. Below we will see how difficult it was for Mersenne in the seventeenth century to found an academy of sciences to the end of creating a platform for safe dissipation of ideas so as to speed up development.

2.5.1 Richard Strauss and Copyright

True copyright laws were rather late to appear, and applied to the publisher rather than to the originator. This still holds for literature, including science. As for music, copyright for published music included the right to perform! It was as late as in 1898 that Richard Strauss founded the association of composers in Germany, and with great difficulty managed to make legislators differentiate the rights of the publisher, proper copyright, (*“Verlegerrechte”*) from the rights of the composer, including performance rights, (*“Urheberrechte”*). See Deppisch, *“Richard Strauss”*.

It was these entrepreneurial talents which made Goebbels offer Strauss to become president of the *“Reichsmusikkammer”* of Nazi Germany, an honour the great composer, unfortunately for his later reputation, accepted, until he was later disposed of for collaboration with Jewish librettists.

2.5.2 Trade Secrets Historically

A change of attitude should be noted. The ethos of science now demands prompt and costless disclosure of discoveries. In times past mathematicians usually communicated only the new theorems to their colleagues, keeping the proofs to themselves.

2.5.2.1 Schmelzer

In the arts things were similar. Composers borrowed without scruples from themselves and others. In most cases the music was processed, but there exist instances of pure theft, such as the sonata by Andreas Anton Schmelzer (not to be confounded with his father Johann Heinrich Schmelzer) to celebrate the escape of Vienna from the siege by the Turks, where he just “borrowed” one of Biber’s *“Mystery Sonatas”*,

spoken of elsewhere, “*The Crucifixion*”, transposing the piece a semitone up, adding one tiny little movement, and giving the movements fancy names referring to the battle. The hammer blows from driving the nails into the body of Christ being reinterpreted as artillery fire on the walls of Vienna.

2.5.2.2 Tartaglia

A similar instance from the same century is the case of Cardano, to whom Tartaglia in confidence disclosed a method of solving cubic equations, and who published the result as his own work. It is not to wonder that artists and scientists became jealous of their secrets.

2.5.2.3 Le Sieur de Sainte Colombe

According to Tilton du Tillet’s “*Le Parnasse Francois*” from 1732, the young violist Marin Marais had to practice qualified “industrial espionage” against his teacher de Sainte Colombe in order to find out the more subtle mysteries of bowing. Du Tillet writes: “*Sainte Colombe was the teacher of Marais, but, having realized after six months that his pupil might surpass himself, he told him that he had nothing more to show him. Marais, who loved the viol passionately, however, wanted to learn more from his master in order to perfection himself in playing that instrument; and, as he had some access to the house, he chose a time in the summer when Sainte Colombe was in his garden hidden in a little plank cabinet that he had built on the branches of a mulberry tree, to the end of being able to play his viol more at ease and with greater delicacy Marais slipped under this cabinet; he listened to his master and profited from some special passages and some special bowings which his master wished to keep to himself. But this did not last for long. Sainte Colombe became aware of the facts and took precautions not to being heard by his pupil again*”. This feather of an anecdote was, by the way, some years ago used in the successful movie “*Tous les matins du monde*” to reconstruct an entire poultry farm.

2.5.2.4 Mozart

We could also cite from Mozart’s letters: Concerning his piano concerto in E-flat (KV 449), lent to his father Leopold, which he wanted back, he writes in May 1784: “*I will be pleased to have patience until I get it back - provided it does not come in the hands of anybody. - I could have had 24 Ducats for it today; - however I find it can be more profitable for me to keep it a few years and then make it known only in engraving (print).*”

And, 2 years earlier to his sister Nannerl concerning a fugue: “*Please do keep your word not to show the music to anybody. - Learn it by heart and play it so, it is not so easy to imitate a fugue.*”

Today all such novelties would immediately be regarded as common property. It also becomes increasingly difficult technically to protect property rights to scientific or artistic innovations in our age of easy mass-communication and mass-reproduction.

These technological improvements on one hand help to protect physically embodied originals in the case they are old and delicate, on the other hand they impede protection of the property rights to the ideas. The public good character of ideas, in various ways, makes it almost impossible to secure the originators their merited rewards.

2.5.3 Mersenne and the French Academy

It is interesting to note that it was in France, about the time Marais spied on Sainte Colombe, that a remarkable attempt was made to lift the inclination to secrecy among the scientists, by Marin Mersenne founding an embryo to the French Academy. Mersenne clearly realized that every scientist would profit from knowing the results achieved and the methods used by others, so as to build their research on a fundament of common knowledge.

Mersenne obviously inspired trust among his colleagues, though the success was only partial. Though Mersenne was one of the few people that Pierre de Fermat at all corresponded with, he could not be convinced to disclose his proofs. Had Mersenne only been a little bit more successful, the three centuries of vain hunting for the proof of “Fermat’s Last Theorem” might not have been necessary.

Mersenne is of interest in the present context also because he in 1634 published his *“Harmonie Universelle”*, which today provides one of the best sources of knowledge concerning historical musical instruments.

We should admit that trade secret has been kept for scientific discovery even in modern times as soon as there is a relation to military aims. Research concerning nuclear physics was quite recently kept highly secret, as is still anything having to do with biological and chemical warfare agents. The same holds true for the purely mathematical discipline of cryptography.

Attitudes vary between periods of war and peace, but a certain degree of secrecy is always there. The same, of course, holds for industrial procedures that may be patented, but here we deal with applied results of little significance for basic science.

On the whole it, however, still holds that attitudes have shifted to much more openness. Perhaps we should not be too boastful over this progress as the changing attitudes may in fact have something to do with the increasing difficulty of keeping secrets in modern society.

2.6 The Stock of Knowledge

Once we decide to consider a substantial part of the cultural goods as embodied ideas, it is natural to ask whether it would be fruitful to define a stock of ideas, information, knowledge, or whatever we wish to call it, as a non-material companion to the stock of capital. Along with capital, labour, and land, it could then be regarded as an input in production.

We could also consider the evolution of the stock in terms of the formation of new ideas and the depreciation of obsolete ones. Using modern computer jargon we might even coin a unit of measurement for knowledge: Bytes, Kilobytes, Megabytes, and Gigabytes. Note in this connection that not only text, but also pictures, and music, are now stored in the same way. Most music notation programs (such as Finale) provide automatic facilities for converting the scores to sound, even to attribute different instruments to the different parts.

We should be watchful, because a page by Shakespeare or Newton may take the same number of Bytes to record as a page of randomly scrambled words from a dictionary! However, in computer memory too, the high-level instructions of very sophisticated programs are coded like simple data or sheer nonsense, so the difference may not be that big after all.

We may also take note of Gödel's demonstration that every mathematical theorem, no matter how deep, and every proof, no matter how ingenious, can be coded as one single number. In his book "*Gödel, Escher, Bach: an Eternal Golden Braid*" Douglas Hofstadter discusses whether a gramophone record containing some message, launched into outer space could be considered to contain any information at all.

For an affirmative answer, the addressee must be supposed to possess a gramophone, have access to electricity, understand how to operate these things, and know the language in which the message was recorded.

2.6.1 Knowledge and Capital

But, again, the situation for ideas is no worse than for modern specialized machinery, where an obsolete piece, fitting no operating system, is completely worthless. This becomes increasingly true with increasing specialization. A pair of dentist's pincers could still be used in woodworking, whereas a program module for a modern dishwasher cannot be used for any other purpose than in a dishwasher of exactly that brand for which it was produced.

Ideas becoming obsolete are scrapped, just like machines. A seeming difference is that machines wear out from use, whereas ideas wear out from non-use. Looking closer we, however, find that, though machines wear out from fatigue when in operation, they also wear out from corrosion and lack of attention when left idle. Ideas and machinery both also wear out from becoming obsolete, which is an attribute derived from the macro environment, when the idea or the machine does not fit in any longer.

There is just one reason why it is of doubtful value to introduce the stock of knowledge into economic theory as a companion to the stock of capital: It is hardly ever possible to distinguish a pure input of knowledge in the production process as distinct from the inputs of labour and capital! A new idea is always incorporated either in a new design of some capital equipment, or else embodied in some workman doing his job in a new way.

In the old guild system, apprentices were allowed to own a small well defined set of simple hand tools. Thus, some capital could be regarded as embodied in labour. Likewise a serfdom economy, such as Imperial Russia or the pre civil war America, would embody labour in land.

Except for the obvious case of capital embodied in cultivated land, we therefore have to look very carefully, only to find very particular examples of little significance, such as those above, where there are any problems at all in discriminating between capital, labour, and land. In attempts to isolate knowledge from capital and labour, the problems are, on the contrary, always prevalent.

2.6.2 Storage

There are peculiarities pertaining to the nature of the stock of knowledge. Before the advent of the printed word, knowledge was communicated exclusively by oral tradition, from individual to individual, often within a family or a local community.

Procedures such as the making of steel, known to the Hittites, or silk and porcelain, known to the Chinese, could be kept secret over long time periods. The stock of knowledge indeed was made of the ethereal stuff carried in the minds of people. Still in 1710, Elector Augustus the Strong, could imprison alchemist Johann Friedrich Böttger, discoverer of the composition of chinaware, and director of the Meissen newly founded porcelain factory, upon lifetime in order to keep the secret to the “white gold” of Saxony.

Since books, libraries, and computer files have heaped increasingly huge accumulations of information, there exists an enormous backup made of solid matter. We should, however, regard only that portion of knowledge as operative that is also carried in the minds of people. Every piece of knowledge is a link in a giant network, and can be accessed only through its adjacent links. Once too many adjacent links have decayed, the piece itself becomes inaccessible. The most common reason for such decay is neglect of that particular part of the network of knowledge.

Eventually the genius of a Champollion may be needed to recover how to decipher the hieroglyphics. Like Hofstadter’s record, stored information in itself has no value, except as a potential.

2.6.3 Accessibility

We should mention here that access to knowledge is more complex than the parable of a network seems to suggest. It may be the case that multiple adjacent links of distinct layers are needed for the access.

The process of recovery of lost knowledge is complex in its interdependence. Later we will comment on the recovery of music from the Baroque and Classical periods. The access became difficult because both the original instruments and the

knowledge of performance practice were gone. There is no point in trying out various practices on the wrong kind of instrument, nor is there in setting a standard of quality for the instruments when nobody qualified to judge them is around. Scientific measurement instruments in museums, such as mechanical integration machines, provide another example. For relatively recent instruments there still exist some written instructions.

However, in the case of the mysterious very complex gadget of 32 gear wheels, rescued from an ancient Greek shipwreck at Antikythera in 1900 (Fig. 2.13), it was not understood until 1972 that it must have been used in ancient times to calculate the positions of the sun and the moon, given the positions of the fixed stars.

Suppose something such as a scarcity of electric power, making digital computation impossible would force us to develop mechanical integration machines once again. The task would be formidable, because their working was based on a combined use of advanced mechanical clockwork engineering and differential



Fig. 2.13 The mysterious Antikythera gearbox. It was found by some Greek fishermen and sponge divers in 1900 in a shipwreck close to the tiny island of Antikythera where the fishermen took shelter during a storm. It could be dated from the first century BC. The perishable metal wheels had of course decayed but when the gadget dried it showed a complex system of dials and gearwheels. In 1972 Derek Price, using X-ray, found out the entire complex system of 32 gear wheels moving together when a protruding central axis was rotated. By the ratios of the gears he was able to establish that it had been used as a complex analog computer for calculating the positions of the sun and moon in relation to those of the fixed stars. Nobody suspected that antique technology had achieved such a level of sophistication, the whole thing more resembling some eighteenth century clockwork. Notably it took 70 years to decipher the use of the gadget

geometry, two fields that have both been neglected during the triumph of the digital revolution.

It cannot be overestimated how much a device such as the computer actually contributes to shape the structure of knowledge. The whole field of calculus, based on the elementary trigonometric and hyperbolic functions, would probably be nonexistent today, had computers and algorithms been available in the eighteenth century. Why bother with all the intricate interrelations between those functions, which themselves are nothing but solutions to specific differential equations, if we could numerically solve any other differential equation we needed to consider?

2.7 Explosion of Science and Education

2.7.1 Difficulties to Control and Access Information

Recent developments in computer technology and adjacent areas may be regarded as responses to storage problems for the perpetually accumulating quantity of information. Replacing books by microfiches, microfiches by magnetic records, and magnetic records by optical laser tracks, reflects an aim at compactification.

In his brilliant book *“Does God Play Dice?”* Ian Stewart estimated the current yearly output of scientific periodicals to a number around one thousand with at average one thousand pages each. Accessing this accumulating knowledge is bound to become an ever more tricky problem, despite the fragmentation of intellectual work in many specialized compartments, which itself is a consequence of the access problem.

Davis and Hersh in *“The Mathematical Experience”* report that, whereas a mathematics student in 1915 was supposed to be prepared to cover the whole field at examination, in 1940 according to John von Neumann an average mathematician would know about 10 % of the field. Comparing the reading list of a graduate student around 1985 with the contents of a normal reference library Davis and Hersh come to the depressing ratio of 60 to 60,000, i.e., one pro mille. According to classification lists of specialities from 1868 to 1979 they further note an increase from about 40 to 3,400 items. They also report Stanislaw Ulam’s desperation at the fact that by the latter time there were an estimated number of 200,000 new mathematical theorems proved each year (Even if neither Poincaré, nor Mandelbrot ever contributed one single item).

The term scientific pollution lies in the air. Through the discussion perspires a slight desperation at the prospect of anybody being able to discern between what is important and what is not, and hence being in the position of giving reasonable advice for the funding of scientific activities.

The whole situation is, of course, much worse in empirical sciences, such as Physics, Chemistry, or Economics. Shortening memory in science, and repetitive duplications of “discoveries”, are evidence of difficulties to control the access to

existent knowledge. The increasing utilization of computerised data bases, using keywords from titles and abstracts, might not be sufficient to cope with access to the accumulating volume of information. Ian Stewart cites the remarkable fact that Lorenz's seminal contribution to chaos theory was overlooked for 10 years because the mathematicians did not have the habit of looking into journals on meteorology, whereas meteorologists were lacking in the mathematical sophistication necessary to understand the contribution, thus creating a delay of decades in the development of the whole field.

2.7.2 Fragmentation

The state of fragmentation also is a bit alarming for the perspective of scientific renewal. As nobody can have any control over his entire discipline it is a safe strategy to play to just continue from any of the tiny riverlets of science, working out from a history of articles over the past 5 years in the few very specialized journals of exactly that branch.

Unfortunately, the more theorems there are proved about more and more particular issues, the less likely is it that they contain anything really significant. In that respect the scientists may have been in a better position once the theorems were not that many but on average more general and more significant.

Truly new ideas highly depend on cross-fertilization, but that becomes constantly more difficult to achieve the more specialized the sciences become. Since the first edition of this book appeared things which were considered as threats by scientists such as Ulam, Stewart, Davis and Hirsh, have meanwhile become true. Journals continued to multiply, and though they rely on "peer" reviews, the (unrewarded) demand on these reviewers is now such that very few make any serious effort. At the same time the requirement that Ph.D. students in their theses present already published articles, makes the inflow of manuscripts just enormous. No tiny already published idea seems to be too insignificant to be pursued by new ones in any tiny modification. At the same time it even becomes difficult to publish anything original that has been dormant in the literature since 30, 40, 50 years. This is partly because few reviewers have the wide view that the originators of such ideas once had, partly because knowing only a tiny bit of the science it is hard for them to believe that if an idea were significant it could have been unexplored for so long even if they cannot find anything when searching the web.

2.7.3 Open Access

A particular danger is attached to the popularity of "open access". It sounds nice to provide anyone with publications for free on the web. But, it just moves publication costs from the publisher to the author, in reality to some research funding agency.

Journal reviewers look at the author's CV, if it is well fed it seems safe to accept, and so a new item can be added to the CV which improves the chances for new grants next time the authors apply for support; and so it goes on in a circle. The funding agencies tend to merge, and are more and more managed by science bureaucrats rather than scientists.

The worst consequence of this is that scientists lose so much time in preparing applications in a way understandable for the bureaucrats and satisfying the day's politically most cherished whims.

2.8 Universities

With change in science production goes fundamental change in university education. European university culture, until the 1960s, heavily depended on seminars where various members of the staff, working with entirely different topics, communicated their results. For that reason the staff members had to keep a broad perspective on their disciplines. Relatively little was regarded as being worth publishing, and national and local "schools" were established, which made visits to other environments really interesting. After large scale production ideals from the US (and presently even more China) overtook the European style, everything is produced for immediate publication, even the most tiny little idea.

We tend to look down on the previous generation as they published relatively little. This fact, however, does not imply that they worked little or were less creative. It might just signify that they were more choosy about what they regarded as being significant enough to merit publication. Everybody is now concerned with h-indices (number of most cited articles cited at least as many times as the number of articles), and citation frequencies. Even new titles such as "much cited scientist" are created. This might be just fun, if it were not the danger that promotions might mechanistically be tied to such things, of which there is ample evidence.

Of course, there is no means to return to Humboldt's ideal of a university, as testified by the growth of the number of "open universities", with no obligation of physical presence for the students, and somewhat anonymous relations between student and professor—the very opposite of Humboldt's concept. See Fig 2.14.

This is a simple fact of numbers. Take just the tiny country of Sweden: The number of Ph.D. students in 1995 was the same as the number of upper secondary school students in 1965 (by the way, over these 30 years the number of full professors in economics had grown to equal the number of undergraduate students at the beginning). The change was definitely not due to population growth which was around 10 %. Some of this can be explained through the dissipation of higher education to an ever wider fraction population. However, some of it must be ascribed to a redefinition of ranks. Let us not forget that Hugo von Hoffmannsthal was a highly acclaimed member in Viennese intellectual life when he was just an upper secondary school student—to an extent that few Ph.D. students of today can aspire at.



Fig. 2.14 The Humboldt University at Unter den Linden in Berlin. The building, originally city palace for Prinz Heinrich of Prussia, was finished in 1766. The university was founded in 1809, and later renamed to honour its founder, Wilhelm von Humboldt (1767–1835), Prussian philosopher and Minister of Education. He is considered as the designer of the Prussian education system, admired and copied in many countries, among them the US, and included an idea of the modern university as science based teaching institution with compulsory lectures and exams assuming close contact between professors and students. It is still a kind of symbol for an ideal university, which may be hard to retain in present day mass education

This is not to say that the evolution is just bad; again the evolution of computers and their networks also present possibilities for new solutions not available in previous times.

Arts, Sciences, and Economics

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