

Penser les futurs : innovation & science-fiction

Vincent Bontems (LARSIM) & Roland Lehoucq (DAp)

Décembre 2018

DE LA RECHERCHE À L'INDUSTRIE



www.cea.fr

SF: l'écart au possible

Que nous manque-t-il pour faire ce que montre la SF?

Manchu (2014)



Le voyage interstellaire

Puissance du premier étage = 120 GW (pendant 165 s) soit \approx 0,7 % de la puissance mondiale produite en 1969...

Un vaisseau de 1 000 tonnes voyageant à 0,1 c a une énergie cinétique :

 $E = 1/2 \text{ m v}^2 = 4,5 \text{ 10}^{20} \text{ Joules}$

Production mondiale d'énergie primaire (2007) = 5 10²⁰ Joules.

Pour atteindre les étoiles, il faut disposer de beaucoup plus d'énergie !

Avec un taux de croissance de 1,5 % par an,

il faut 310 ans pour multiplier par 100 notre production d'énergie...

Décollage d'une fusée Saturn V (100 tonnes en orbite basse ou 47 tonnes sur la Lune).



Le projet Daedalus (1973 – 1978)

Propulsion : moteur à fusion par confinement inertiel.
Vitesse de croisière : 0,12 c.
Combustibles : ³He (escale sur Jupiter) et D.
Charge utile : 450 tonnes.
Puissance du premier étage : 37 TW pendant deux ans.
Durée du voyage : 50 ans, jusqu'à l'étoile de Barnard (6 a.-l.).

Cea 5 discours sur le futur en lien avec l'innovation

1. La **divination** : discours immémorial d'inspiration magique qui annonce un événement.

2. La **prophétie** : discours antique d'inspiration religieuse qui promet un accomplissement.

 L'utopie/dystopie : discours moderne d'inspiration morale qui décrit un état différent.

4. La **futurologie** : discours récent d'inspiration scientifique qui prédit un développement.

5. La **prospective** : discours contemporain d'inspiration philosophique qui anticipe un effet.

Ray Bradbury : « La fonction de la sciencefiction n'est pas seulement de prédire le futur, mais aussi de l'empêcher. »

Ursula Le Guin : « Dick est un prophète, pas parce qu'il jouerait à prédire le futur mais parce que sa vision morale est désespérément lucide. »



Ursula Le Guin : « Toute œuvre dystopique recèle en son sein une utopie cachée, un livre didactique, et donc satirique, et idéaliste. »

Isaac Asimov : « La science-fiction est la branche de la littérature qui se soucie des réponses de l'être humain aux progrès de la science et de la technologie.



Robert Heinlein : « Au moyen de la sciencefiction, l'humanité peut procéder en imagination à des expériences trop dangereuses pour être réalisées dans les faits. »



L'enjeu de la performativité



La science-fiction pense le futur en supposant une **rupture** et en **prévoyant ses effets** : elle change la limite du **possible** pour faire rétroagir cette **innovation** sur le présent.

October 1045. Wireless World

the atmosphere and left to broad-

cast scientific information back to

the earth. A little later, manned

rockets will be able to make simi-

lar flights with sufficient excess

power to break the orbit and re-

possible stable orbits, circular and

elliptical, in which a rocket would

remain if the initial conditions

were correct. The velocity of

8 km/sec. applies only to the

closest possible orbit, one just out-

side the atmosphere, and the

period of revolution would be

about 90 minutes. As the radius

of the orbit increases the velocity

decreases, since gravity is dimin-

ishing and less centrifugal force is

needed to balance it. Fig. r shows

this graphically. The moon, of

There are an infinite number of

turn to earth.

EXTRA-TERRESTRIAL RELAYS Can Rocket Stations Give World-wide Radio Coverage?

ALTHOUGH it is possible, by a suitable choice of frequencies and routes, to provide telephony circuits between any two points or regions of the earth for a large part of the time, long-distance communication is greatly hampered by the peculiarities of the ionosphere, and there are even occasions when it may be impossible. A true broadcast service, giving constant field strength at all times over the whole globe would be invaluable, not to say indispensable, in a world society.

Unsatisfactory though the telephony and telegraph position is, that of television is far worse. since ionospheric transmission cannot be employed at all. The service area of a television station. od site, is only even on a es across. To about a] atry such as cover a mall co Great Bri e a network of trans rs, connected aveguides on VHF relay links. A recent theoretical study' has shown that such a system would require repeaters at intervals of fifty miles or less. A system of this kind could provide television coverage, at a very considerable cost. over the whole of a small country. It would be out of the question to provide a large continent with such a service, and only the main centres of population could be included in the network.

The problem is equally serious when an attempt is made to link television services in different parts of the globe. A relay chain several thousand miles long would cost millions, and transoceanic services would still be impossible. Similar considerations apply to the provision of wide-band frequency modulation and other services, such as high-speed facsimile which are by their nature restricted to the ultra-high-frequencies.

Many may consider the solution proposed in this discussion too farfetched to be taken very seriously. Such an attitude is unreasonable. as everything envisaged here is a

By ARTHUR C. CLARKE

logical extension of developments in the last ten years-in particular the perfection of the long-range rocket of which V2 was the prototype. While this article was being written, it was announced that the Germans were considering a similar project, which they believed possible within fifty to a hundred years.

Before proceeding further, it is necessary to discuss briefly certain fundamental laws of rocket propulsion and "astronautics." A rocket which achieved a sufficiently great speed in flight outside the earh's atmosphere would never return. This "orbital" velocity is 8 km per sec. (5 miles per sec), and a rocket which attained it would become an artificial satellite, circling the world

(HOURS)

(km/sec.) VELOCITY CREITAL VELOCITY 15,000 20,000 25,000 30,000 35,000 40,000 45,000 5.000 10.000 DISTANCE FROM CENTRE OF EARTH (KILOWETRES)

Fig. I. Variation of orbital period and velocity with distance from the centre of the earth.

The German transatlantic rocket Ato would have reached more than half this velocity.

It will be possible in a few more years to build radio controlled rockets which can be steered into such orbits beyond the limits of would have a period of about four and a half hours.

It will be observed that one orbit, with a radius of 42,000 km, has a period of exactly 24 hours. A body in such an orbit, if its plane coincided with that of the





STATION



L'ascenseur spatial

Proposé en 1959 par Y. Artsutanov et popularisé par Arthur C. Clarke (*Les fontaines du paradis*, 1979) Charles Sheffield (*La toile entre les mondes*, 1979)



Le cylindre de O'Neill (1974)

	Natural sunlight from planar	Table 1. Possible Stages in the Development of Space Communities				
Valley 3	Solar 1	Length del (km)	Radius (m)	Period (sec)	Population*	Earliest estimated date
		1 1 2 3.2 3 10 4 32	100 320 1000 3200	21 36 63 114	$\begin{array}{c} 10\ 000\\ 100-200\ \times\ 10^{3}\\ 0.2-2\ \times\ 10^{6}\\ 0.2-20\ \times\ 10^{6} \end{array}$	1988 1996 2002 2008
Solar 2	* Popu conv	ulation figures are entional agricultu	for double unit; h ire.	nigher figures a	re the approximate	ecological limits, fo

natural sunlight, an earthlike appearance, efficient use of solar power and of materials. The most effective geometry satisfying all of these conditions appears to be a pair of cylinders. The exprements of afficient us

economics of efficient us tends to limit their size miles in diameter, and per miles in length. (See these cylinder pairs, th area is devoted to living s and forest, with lakes, trees, animals and birds ment like most attrac Earth; agriculture is ca where. The circumferen into alternating strips ("valleys") and window a The rotation period is two the cylinder axes are a

toward the Sun. Because the Moon is both of titanium and of a likely that these metals w tensively in the colonies. tism, though, the calculat inder structure has been use of steel cables, to for (longitudinal members ca mospheric forces on the circumferential hands (ca mospheric force and the weights of the ground, of and of themselves. For calculation and the assu cludes, see the box on p steel cables are bunche coarse mesh in the windo bands there subtend a v 2.3×10^{-4} radians, abou diffraction limit for the s ed human eye, and so are

The colonization of space

Careful engineering and cost analysis shows we can build pleasant, self-sufficient dwelling places in space within the next two decades, solving many of Earth's problems.

Gerard K. O'Neill

A

PHYSICS TODAY / SEPTEMBER 1974 33

Vallev 1

2000 people and equipment

Dehydrated food

Totals

200

600

>500 000

¹ Includes replenishable reserves to be used to initiate construction of Model 2, and so are higher

200

600

10 000

The length of a day in each community is controlled by opening and closing the main mirrors that rotate with the cylinders. The length of day then sets the average temperature and seasonal variation within the cylinder. Each

thought of as a heat o 3×10^8 tons of water; it exchange, the warmaylight would be about our. As on Earth, the e is higher because the an a few centimeters be does not follow the

al species that are enth by agricultural and cal residues may find h in the space colonies, es are unnecessary, agare physically separate , and industry has unr recycling.

n figure 1, it is possible in Earth features: the is taken from an aerial section of the Grand Wyoming. The calcuheights as seen in the of summer weather on adiabatic lapse rate of neters and a dew-point 6 deg per 300 meters, nidity and a temperaen zero and 32°C, the ts range between 1100

al areas are separate reas, and each one has for the particular crop avity, atmosphere and

ntrol

La station Apogeios (2011)







La SF peut faire obstacle

Quand un savant distingué mais vieillissant estime que quelque chose est possible, il a presque certainement raison ;

mais lorsqu'il déclare que quelque chose est impossible, il a probablement tort.

Première loi d'Arthur C. Clarke



Toute technologie suffisamment avancée est indiscernable de la magie. Troisième loi d'Arthur C. Clarke



La SF pense des futurs



La SF permet une **défixation**.

La SF crée un futur désirable.

La SF révèle un choix stratégique.

L'avenir ne peut pas être prédit, mais l'on peut inventer des futurs. Dennis Gabor