BEING HUMAN
Giorgio Mottola
In collaboration with Alessia Marzi

GIORGIO MOTTOLA OFF-SCREEN
Human evolution until now has followed the slow pace of nature. After the appearance of primates on the Earth, it took tens of millions of years to learn to walk erect. Sight, hearing, smell and all the organs of a living being are the outcome of an evolutionary process that took billions of years. We believed that evolution had long since reached its culmination. Yet we are perhaps at the beginning of a new transformation of human beings.

HANNES SJÖBLAD - BIOHACKER - EPICENTER
It is as if we were living inside a burqa. This is our sensory universe; we try to perceive and understand the world but we are locked up inside this prison.

GIORGIO MOTTOLA OFF-SCREEN
And if the body is conceived as a limitation, then that limit has to be overcome. This is why mankind has begun to apply technology to modify and improve the body and its biology. The outcome is a human having more than five senses, robotic arms and legs, who is stronger and more intelligent. A human who is much more than just a human.

NEIL HARBISSON - CYBORG ARTIST
I call myself a cyborg because I physically and biologically joined cybernetics. I don't use and don't wear technology: I am technology.

SIGFRIDO RANUCCI IN THE STUDIO
He looks like a joker and probably is one. What's the problem? That a national government has believed him and has virtually recognized him as the first cyborg man in the history of mankind. It resembled science fiction and we're right in it. Cyborg is the combination between cybernetic and human. And this will be an epoch-making revolution that will not even take all that long to take root because an entire generation was born in the mid-seventies and grew up among cyborgs, seeing films with *RoboCop*, *Edward Scissorhands* and the *Star Wars* saga. Or else grew up reading the novels of William Gibson and his heroine Molly - a bodyguard with exceptional and extraordinary powers. Or reading *In the Garden of Iden* by Kage Baker about the company that had immortality up for sale. The investigation this evening is an injection of trust, hope and enthusiasm because we will see technologies capable of giving legs, hands, arms, hearing, sight and even brain faculties back to people who have lost them. This is only one part but one which nevertheless raises questions. What if these technologies left laboratories and ended up in the hands of marketing experts or worse still people who aspire to create a super man? What would happen? It might seem like science fiction but people are working on it. Facebook and Elon Musk are developing projects focusing on the brain that can read our thoughts. So, what would we say if tomorrow someone asked us to put this microchip in our brains? An informed response would require us to know about the risks. Yet, as we are thinking about it, there is a nation that is already using them. Over to Giorgio Mottola.

GIORGIO MOTTOLA OFF-SCREEN
For almost twenty years, even cats and dogs have to be officially registered. While we carry our identity card in our pocket, they "wear" it.

FRANCESCA BELLINI - ROME 1 LOCAL HEALTH AREA VET
I'm implanting the microchip under the animal's skin. There. I'm now going to read the microchip's number with this reader.

GIORGIO MOTTOLA
This is rather as if it the animal has its own ID card.

FRANCESCA BELLINI - ROME 1 LOCAL HEALTH AREA VET
Yes. And the animal's identity card is linked with its owner.

GIORGIO MOTTOLA
And would you "wear" this microchip yourself?

FRANCESCA BELLINI - ROME 1 LOCAL HEALTH AREA VET
No.

GIORGIO MOTTOLA OFF-SCREEN
In Sweden, the answer to this question by several thousand people was: why not! This is Stockholm Central Station. Swedish commuters are different from all other commuters in the world.

GIORGIO MOTTOLA
So you have a chip implanted in your hand? Can you show it to us?

BEATRICE ALVOLIN
Of course, you can touch it if you want.

GIORGIO MOTTOLA
How does it work?

BEATRICE ALVOLIN
It works with the railway app. I registered, so when I buy a ticket it is sent directly to the chip.

GIORGIO MOTTOLA
Why did you agree to do this?

BEATRICE ALVOLIN
When you work full-time and have children, there are so many things you have to think about. The chip makes life easier.

GIORGIO MOTTOLA
Do you often lose your train tickets?

BEATRICE ALVOLIN
Always, all the time.

GIORGIO MOTTOLA
Really?

BEATRICE ALVOLIN
I'm very disorganised.

GIORGIO MOTTOLA OFF-SCREEN
Ticket collectors pass the reader over to the passenger's hand to check the validity of the ticket. The Swedish State Railways were the first public transport company in the world to experiment with implantable chip technology.

STEPHAN RAY - SPOKESPERSON / SWEDISH RAILWAYS
Passengers asked us to use the chip as a ticket and we thought it was a fantastic idea.

GIORGIO MOTTOLA
How many passengers are currently using implanted microchips?

STEPHAN RAY - SPOKESPERSON / SWEDISH RAILWAYS
There are currently around 2200. There are around one hundred new users every month.

GIORGIO MOTTOLA OFF-SCREEN
The microchip revolution started off from this Stockholm building named Epicenter: it's a mega co-working centre where young Swedish people and large companies such as Google have their own workstations.

JOWAN ÖSTERLUND - BIOHAX
The door is closed. I pass my chip here and it opens ... quicker, simpler and more convenient.

GIORGIO MOTTOLA OFF-SCREEN
Implanted chips can be used to access computers, activate printers and pay at the self-service bar.

JOWAN ÖSTERLUND - BIOHAX
If you want to buy a drink at the bar ... you simply log in, take what you want to drink, scan it and it's paid for.

GIORGIO MOTTOLA OFF-SCREEN
Jowan Österlund is the founder of Biohax, a company based in Epicenter that specialises in microchips.

JOWAN ÖSTERLUND - BIOHAX
The implant area is prepared by disinfecting it. When it's clean, all you have to do is lift the skin ... take a breath ... and ... it's done! It takes less than a second to implant the chip.

GIORGIO MOTTOLA
Did it hurt you?

MAN
Not at all. It was painless. Quite unlike piercing.

GIORGIO MOTTOLA OFF-SCREEN
These chips are the evolution of the ones implanted in animals. They are made of bioglass and emit an NFC signal - a wireless technology contained in all smartphones - that allows data to be transmitted only at very close distances.

HANNES SJÖBLAD - BIOHACKER - EPICENTER
You can use them in place of shop loyalty and discount cards. Or you can upload files to your chip and use it like a USB pen-drive. For example, you can store your personal and health data in it. I can also use the chip instead of a password: instead of typing the PIN, pass your hand close to the phone to unlock it. And for true nerds, you can even use it to start your car. Yet the truly most important thing is that an implanted chip turns your body into a part of the Internet of things.

GIORGIO MOTTOLA OFF-SCREEN
Yet some people have already regretted it. Such as Andreas: some time ago he was the first man in the world to board a flight plane using his implanted chip instead of a boarding pass.

ANDREAS SJÖSTRÖM - VICE PRESIDENT SOGETI
I think using such tools is dangerous without having first performed sufficient tests to see if they are really harmless to human health. In addition, there is a whole series of privacy issues. We do not know if users really have full control over the data produced by these chips.

GIORGIO MOTTOLA
I imagine that you had the chip removed.

ANDREAS SJÖSTRÖM - VICE PRESIDENT SOGETI
No, it's here, see ... you can feel it, it's still there. Removing it would involve surgery.

GIORGIO MOTTOLA OFF-SCREEN
In the United States, where the Food and Drug Administration authorised the use of microchips in the health sector, many public protests took place only a few years ago. The main general worry was that microchips may quickly turn into highly invasive tools for social and individual control purposes.

JOWAN ÖSTERLUND - BIOHAX
If Google were to offer me 100 million dollars tomorrow in exchange for the ability to track the information and data of everyone with implanted chips, I would say: no! We merely seek to offer people an extra choice and that's why we work only with companies that share our values.

GIORGIO MOTTOLA OFF-SCREEN
And more and more companies worldwide are contacting companies such as Biohax. The idea of applying such technology to its workers also came to Amazon, that only a few weeks ago presented a patent for a removable bracelet which tracks the movements of workers and guides them in goods pick-up operations. Bracelets and microchips may well soon become everyday items in the workplace.

HANNES SJÖBLAD - BIOHACKER - EPICENTER
Microchip technology exists and is set to expand. This is why I think it's marvellous that biohackers and activists have begun looking into them. Because they counterbalance national governments and multinationals. As we say in the biohacker world, there are two reasons why you have to understand new technologies. The first reason: because it's useful to understand how they work. Second: you must understand how they can be used against you, since this will certainly be the case.

GIORGIO MOTTOLA OFF-SCREEN

Yet implanted chips are just the start of transformation of the human body and biology that scientists and biohackers such as Hannes have been working on for years. The aim is to accelerate and modify human evolution. In other words, to improve - through technology - the current abilities of human beings and create new ones. In short, revolutionise and move beyond nature's original design for humans.

SIGFRIDO RANUCCI IN THE STUDIO
If we have limitations, there is almost certainly a reason for them. There is no doubt that if you insert a connected object into your body, it can easily become a tool for control or even manipulation. And this occurs without our knowledge. Former US Vice President Dick Cheney, someone with access even to first-hand information, said in 2007 that he removed and changed his pacemaker for one in wireless mode. This was because he was worried about being hacked. A few months ago, 10 years later, the Food and Drug Administration recalled as many as half a million pacemakers because they considered them unsafe and potentially at risk of cyber attacks capable of changing the rhythm of the heartbeat. There is also recent case of Cambridge Analytica which Report investigated more than one year ago. It played a role in the election of Trump and even the pro-Brexit vote. It obtained and used the profiles of Facebook users and created software that influenced their election choices. It also had contacts and even worked with Italian political parties but they do not recall which ones. So, Washington, London, Brussels and our own Agcom in Italy asked Zuckerberg for explanations. Who merely said "Sorry, we made a mistake. We can still be friends as before and move on". Nevertheless, we realised that we must never be caught unprepared. This is an epoch-making change and we are talking about manipulating the body. And they reached points we never thought could be attained: reading and modifying our thoughts. The project is named the Brain Computer Interface. Technology is made welcome when it helps bridge a handicap caused by nature or destiny. Yet if and when it helps create super-workers, super-soldiers or even supermen?

GIORGIO MOTTOLA OFF-SCREEN
The Italian Institute of Technology has worked for many years to develop and perfect robotic prostheses. This is currently the most advanced and sophisticated bionic hand prototype in the world.

LORENZO DE MICHIELI - DIRECTOR OF THE JOINT IIT-INAIL LABORATORY
To all intents and purposes, it connects with the user's peripheral nervous system in a non-invasive way through two myelectric surface sensors that detect the surface potential of the residual muscles of the stump.

GIORGIO MOTTOLA OFF-SCREEN
When they contract, as happens every time we move our hands, this movement is transmitted to the robotic hand.

GIORGIO MOTTOLA
When I contract the muscles here, I make this movement and the hand closes. When I relax them, the hand opens.

LORENZO DE MICHIELI - DIRECTOR OF THE JOINT IIT-INAIL LABORATORY

The most interesting thing is that the hand closes all the stronger the more the muscles are contracted. The hand can pick up very different objects. The object having a very complicated, difficult shape and the hand ...

GIORGIO MOTTOLA
Yet it manages to pick it up. How strong is the grip? Let's try with a bottle.

LORENZO DE MICHIELI - DIRECTOR OF THE JOINT IIT-INAIL LABORATORY
The grip is strong if you contract the muscles sufficiently ...

GIORGIO MOTTOLA
Can I open the bottle?

LORENZO DE MICHIELI - DIRECTOR OF THE JOINT IIT-INAIL LABORATORY
Sure.

GIORGIO MOTTOLA
I really can manage to open the bottle!

LORENZO DE MICHIELI - DIRECTOR OF THE JOINT IIT-INAIL LABORATORY
Yes, of course ... and wow! Of course you can.

GIORGIO MOTTOLA OFF-SCREEN
There are already dozens of people in Italy who have been using similar robotic hands for years.

MIRKO MEINI
I can do everything. I wear it from the morning and I take it off at night before going to bed.

GIORGIO MOTTOLA
Does it feel like a foreign body?

MIRKO MEINI
It's like a part of me. Like, I don't know, like a pair of shoes, a pair of glasses, a wristwatch. You wouldn't go out without it.

GIORGIO MOTTOLA OFF-SCREEN
Mirko's bionic hand was created by the Biorobotics Institute of the Sant'Anna School of Advanced Studies in Pisa, where they also develop prototypes of robotic legs.

NICOLA VITIELLO - INSTITUTE OF BIOROBOTICS, SANT'ANNA SCHOOL OF ADVANCED STUDIES
Imagine having sensors similar to those in your mobile phone, right? If you tilt the mobile phone, the mobile phone understands how it is tilted. And then insert them in certain critical parts of the body. For example, if I stand still on both legs, and inasmuch on both feet, the robot is aware of this and so is prosthesis. As movement begins, the sensors convey this information - and what does the prosthesis do? It understands at that particular moment that the knee must bend or be extended or the ankle has to move.

GIORGIO MOTTOLA OFF-SCREEN

This hybrid between people and robotics, hands and legs, is simply the first step. Exoskeletons - robots that are "worn" to replace, improve or enhance the movements of the human body - may soon appear in everyday life

LORENZO DE MICHIELI - DIRECTOR OF THE JOINT IIT-INAIL LABORATORY
Every time the torso pushes forwards, the machine takes a step with a pendulum movement rather similar to what normally occurs when we walk in a natural way. When we have to stop the machine, the torso is moved backwards and the machine then evens out the step into a balanced position.

GIORGIO MOTTOLA
Does this mean that a paraplegic person or people who simply have difficulty using their legs can walk unaided thanks to this exoskeleton?

LORENZO DE MICHIELI - DIRECTOR OF THE JOINT IIT-INAIL LABORATORY
Yes, exactly: people can walk alone with a certain fluidity.

GIORGIO MOTTOLA
Could an exoskeleton of this kind also significantly increase a person's speed?

LORENZO DE MICHIELI - DIRECTOR OF THE JOINT IIT-INAIL LABORATORY
Other types of objects sharing a common root can be derived to perform what in reality are very different tasks.

DARPA PROMOTIONAL VIDEO - DEFENSE ADVANCED RESEARCH PROJECTS AGENCY
We are building a world where science fiction is becoming reality. Build an exoskeleton and the rest will follow. Relying only on the human body may mean only choosing between the outcome of the mission and safety. Yet if innovation is integrated with the human body, unstoppable potential can be achieved. The combination of safety and human empowerment. A new era of military protection systems has arrived.

GIORGIO MOTTOLA OFF-SCREEN
This is the promo video for the exoskeleton developed by Darpa, the Department of Technological Experimentation of the American Army that has an annual budget of over 3 billion euros. The exoskeleton has cost about 80 million euros and, through motors inserted in the joints, helps increase speed and effortlessly carry weights of over 60 kg on the shoulders. This improves the performance of soldiers and their protection against enemy attacks. In short, it transforms men into supersoldiers.

DARPA PROMOTIONAL VIDEO - DEFENSE ADVANCED RESEARCH PROJECTS AGENCY
The future is now.

NICOLA VITIELLO - INSTITUTE OF BIOROBOTICS, SANT'ANNA SCHOOL OF ADVANCED STUDIES
Even in the case of these recent programs undertaken by Darpa, the aim was more to help soldiers in their logistics tasks. In particular, there was a program in the 2000s involving transport of a backpack to help soldiers carry them essentially with less effort.

GIORGIO MOTTOLA OFF-SCREEN

While we wait for supersoldiers to make their appearance on battlefields, superworkers are already a reality. To compete with robots in factories, workers themselves must now be "robotized" by wearing exoskeletons that facilitate tasks and improve performance.

NICOLA VITIELLO - INSTITUTE OF BIOROBOTICS, SANT'ANNA SCHOOL OF ADVANCED STUDIES
Imagine I want to help people who work a great deal of the time with their arms held upwards, for example... They get tired because the muscles holding up their arms are constantly stressed. There are also jobs requiring people to lift "only" two or three kilos but do so 50 times a day. It is self-evident that such a task in the long run will cause back pain.

GIORGIO MOTTOLA OFF-SCREEN
And while until now we were mostly worried that robots would take away our jobs, in the near future we will have to handle the hypothesis that robots will actually mean we can stay at work much longer.

NICOLA VITIELLO - INSTITUTE OF BIOROBOTICS, SANT'ANNA SCHOOL OF ADVANCED STUDIES
Actually, I think it would be more appropriate to find ways not to have to work until you are 65. But if there is no alternative? We have to make sure that people who are obliged to stay at work for longer and longer periods can do so by ensuring the best ergonomic conditions.

GIORGIO MOTTOLA OFF-SCREEN
Quite a few Italian industrial companies have adopted this new tool for their workers, including FCA, which launched three exoskeletons in its Melfi factory.

MAURIZIO LANDINI - CONFEDERAL SECRETARY CGIL (TRADE UNION)
We have to understand why and for what purpose these things are being used. If the goal is to use it not simply to improve working conditions or make work less tiring but to study workers' movements with a view to replace them, then the difference is clear.

GIORGIO MOTTOLA OFF-SCREEN
The Sala del Mappamondo in the Palazzo Pubblico, Siena, is home to Simone Martini's painting "Maestà": . The masterpiece is striking in view of a mysterious aspect concerning Saint Crescentius of Rome. The Saint is in fact depicted with six fingers. Seven hundred years later, the University of Siena - a leading centre in the robotics field- studied and made the sixth finger.

GIORGIO MOTTOLA
Simone Martini designed it and you then made the sixth finger?

DOMENICO PRATTICHIZZO - PROFESSOR OF ROBOTICS - UNIVERSITY OF SIENA
Yes, there is a perfect match between the past and the future of humanity.

GIORGIO MOTTOLA OFF-SCREEN
The sixth finger was designed with the intention of helping people who no longer have fully functional hands.

ALESSANDRO BONDI - EXPERT IN ASSISTIVE TECHNOLOGY
It is an appendix of my arm that, after the stroke was ... well, stopped cooperating and did not ...

GIORGIO MOTTOLA
Did not work as it should.

ALESSANDRO BONDI - EXPERT IN ASSISTIVE TECHNOLOGY
Precisely. An impulse from my forehead can close my finger.

DOMENICO PRATTICHIZZO - PROFESSOR OF ROBOTICS - UNIVERSITY OF SIENA
For a normally able person, using a sixth robotic finger significantly improves performance. In other words, I truly create a superman. Thanks to the sixth finger, I can get close to this object and create a grip that was anatomically impossible. If I had to drink water from this bottle, I could keep this hand free for other tasks and consequently only use my right hand augmented with the sixth finger to grasp the bottle as I am doing now, closing my hand into a strong grip . At this point, I release my thumb and index finger again to open the bottle without trouble and drink.

GIORGIO MOTTOLA OFF-SCREEN
Yet to enhance the human body and, above all, restore blocked or damaged bodily faculties, there is another approach that the scientific world has been following for some time that is now beginning to yield its first miraculous results: connect computers directly with the brain. When she was ten, Lina suffered a retinal disease that has made her completely blind today.

LINA COLOMBI
Without glasses, I can only distinguish between day and night.

GIORGIO MOTTOLA OFF-SCREEN
But Lina's are not ordinary glasses. They are connected to a microchip implanted in the retina that is connected in turn to the optic nerve through these tiny electrodes.

LINA COLOMBI
Thanks to these glasses, I can see more light, more shadows and more shapes.

MAURA ARSIERO - DIRECTOR BUSINESS DEVELOPMENT SECOND SIGHT
These glasses incorporate a small camera. This camera is the patient's eye.

GIORGIO MOTTOLA
What's this here in the middle?

MAURA ARSIERO - DIRECTOR BUSINESS DEVELOPMENT SECOND SIGHT
This round thing in the middle.. . The information is transmitted to this tiny computer and converted into an electrical pulse sent to the electrodes as such.

GIORGIO MOTTOLA
So, to all intents and purposes, the images captured with this camera are sent to the brain?

MAURA ARSIERO - DIRECTOR BUSINESS DEVELOPMENT SECOND SIGHT

Yes, simplifying things a great deal, this is what happens.

VALENTINA CARBONE – SECOND SIGHT
Lina, hang on while I make them for you.

LINA COLOMBI
So, there's something horizontal, something vertical and something horizontal again. Well, it can be only the letter "I".
I'm always unsure because I'm a bit nervous!

VALENTINA CARBONE – SECOND SIGHT
Don't get excited!

GIORGIO MOTTOLA OFF-SCREEN
The tools that allow you to connect computers to the brain are called Brain Computer Interfaces. And it is in places like these - the Wyss Centre in Geneva - that we are laying the foundations for a future we have so far only glimpsed in science fiction films.

JOHN DONOGHUE - DIRECTOR WYSS CENTRE GENEVA
The Brain Computer Interface allows the brain to communicate with the outside world. It works through electronic devices capable of monitoring brain activity and understanding exactly what the brain is doing.

GIORGIO MOTTOLA OFF-SCREEN
You can see extraordinary events such as this when we connect the brain to a computer here at the Wyss Centre. A woman who has been paraplegic for more than 30 years now manages to move a robotic arm exclusively with the power of thought.

JOHN DONOGHUE - DIRECTOR WYSS CENTRE GENEVA
It looks like magic but it isn't. If the computer is able to understand that a person is thinking about moving an object, that person simply has to concentrate and think about the movement. The computer analyses brain activity and translates it.

GIORGIO MOTTOLA OFF-SCREEN
And the most complex problem is precisely that of understanding the language of the brain. While human languages are based on letters or graphic signs, the brain's alphabet is made up of the electrical impulses of neurons: every action or thought is matched by a specific sequence of neurons that "switch on" and interconnect electrically with other neurons. The difficulty lies in the fact that there are billions of interconnections and when neurons communicate with each other they do so at an astonishing speed. The human-brain language dictionary can be compiled using an encephalographic helmet such as this one, made up of electrodes or microphones that record neuron activity and send signals to the computer. But the helmet only manages to capture activity on the surface of the brain. The best instrument is a chip implanted inside the cerebral cortex.

JOHN DONOGHUE - DIRECTOR WYSS CENTRE GENEVA
A few years ago we developed a prototype chip named "Neurocomm". More recently, we managed to design this much smaller device, which is implanted inside the head and is not visible from the outside. It does the same things, transmits all brain signals to the outside through a radio wave connection, just like wi-fi. Yet this will only really work fully in the future.

GIORGIO MOTTOLA OFF-SCREEN
Since it is still too invasive, the era brain chips is still in its infancy. Yet what would happen if technology of this kind were to be used outside the medical-scientific field? What, for example, if it were used in the marketing world? And we are not talking about science fiction. The barrier opposing technology applied to the brain for commercial purposes was overcome years ago. Italian pioneers in this field include these two young entrepreneurs who founded a very unusual company in Bolzano.

GIORGIO MOTTOLA
What readings are you able to take of the human brain?

ANDREA BARISELLI - CO-FOUNDER THIMUS
Emotions.

GIORGIO MOTTOLA
So, you are able to understand the sensations and emotions that a product arouses.

ANDREA BARISELLI - CO-FOUNDER THIMUS
Absolutely.

GIORGIO MOTTOLA OFF-SCREEN
This is done through a helmet. To understand how it works, we shall put it on and experiment with an apple.

GIORGIO MOTTOLA
Does this helmet help you understand what I felt while I ate the apple?

ANDREA BARISELLI - CO-FOUNDER THIMUS
Yes, in this case yes. I optimized one metric, in this case pleasure, divided over the time you were enjoying the apple. And what we can see is a small trend. This is an indicator but we can obviously do a lot more.

GIORGIO MOTTOLA
Over and above apples, can you do this with other kinds of product?

ANDREA BARISELLI - CO-FOUNDER THIMUS
Any product at all; we have done a great deal with chocolate and wine.

GIORGIO MOTTOLA OFF-SCREEN
Thimus also works in the fashion and clothing sector and has started a project with Boeing to assess comfort levels in aeroplanes, as well as with leading car builders. And the automotive sector is precisely one of the areas most interested in new ways of exploiting the brain computer interface. A few weeks ago, Japanese giant Nissan presented the world premiere of the first car driven with thought, thanks to the help of the electroencephalographic helmet. The car receive commands from the brain without the intermediation of hands or feet.

BRUNO MATTUCCI - MANAGING DIRECTOR NISSAN ITALIA
When I'm faced with a dangerous situation, it is self-evident that the brain first analyses the situation and then takes action. So, all this involves reaction times. Well, if instead I can use a system to intercept the brain wave when I realize there is a

danger and thereby anticipate, so to speak, everything in the chain of control of the human body, I can take action much more quickly.

GIORGIO MOTTOLA OFF-SCREEN
The brain can also be used to adjust temperature. The car reads your thoughts for the duration of the journey and on its own understands whether you are hot or cold.

GIORGIO MOTTOLA
This means that the driver's brain activity is constantly monitored.

BRUNO MATTUCCI - MANAGING DIRECTOR NISSAN EUROPE
Yes, it is constantly monitored and filtered.

GIORGIO MOTTOLA OFF-SCREEN
Projects capable of monitoring brain activity much more constantly and effectively, and thereby enhance the brain computer interface, through chips implanted in the brain are being developed by other multinational companies of the calibre of Facebook. However, its projects are top secret. And we only know the little news they allow out

REGINA DUGAN - HEAD OF HARDWARE DEPARTMENT FACEBOOK
We are keen to create a system capable of typing 100 words per minute, that is 5 times faster than you can today with a smartphone. Because you will be able to type directly through your thoughts!

GIORGIO MOTTOLA OFF-SCREEN
The other major corporation interested in chips implanted in the brain is Neuralink, the company owned by Elon Musk - the founder of Tesla who plans to take man to Mars. Once again in this case, Neuralink's projects are secret but according to Elon Musk himself the goal is to find ways to integrate artificial intelligence and the human brain.

ELON MUSK - CEO TESLA AND SPACEX
We are already cyborgs. Effectively, we all have superpowers thanks to computers or smartphones. Yet in order to link up in a truly symbiotic way with artificial intelligence, an interface with the brain is needed, a direct connection between the brain and the computer.
I think the best solution is to have a level of artificial intelligence inside the brain that works symbiotically with you just like your biological brain.

WALT MOSSBERG - JOURNALIST
But is this something that requires surgery?

ELON MUSK - CEO TESLA AND SPACEX
No.You can inject it into the veins through the blood or directly into the jugular. From there it quickly reaches the neurons.

GIORGIO MOTTOLA OFF-SCREEN
Elon Musk's project effectively means incorporating a computer, i.e. artificial intelligence, into the brain. This would mean enhancing human cognitive activities by hybridizing the brain with the computer through microchips. To understand what risks are involved, we contacted a leading figure in neuroscience - Niels Birbaumer, one of

the pioneers of the brain computer interface in Europe who continues to develop this technology in the therapeutic field.

NIELS BIRBAUMER - NEUROSCIENTIST WYSS CENTRE GENEVA
He would like to use these techniques even in healthy people to increase performance, activity and thoughts. It is undoubtedly big business. But we do not know the negative consequences involved, which may well be dramatic, since we have no idea what changes occur in the brain after implanting so many electrodes, how brain activity changes. We can permanently modify our personalities with these things.

GIORGIO MOTTOLA OFF-SCREEN
It resembles the plot of a dystopian film but we are talking about scenarios that are effectively taking shape. Hundreds of researchers around the world are working on a project capable of inducing certain thoughts in the human brain. They include researchers at IIT in Genoa who focus exclusively on therapeutic applications.

STEFANO PANZERI - COORDINATOR IIT ROVERETO
It is something that initially, when it is possible to develop these techniques in a safe and complete way, should be used to restore basic functions, such as sight and hearing in particular clinical cases, when eyesight or hearing functions are lost but the brain remains active. However, in the even longer term, it can also be seen as a tool for manipulating people's cognitive abilities.

GIORGIO MOTTOLA OFF-SCREEN
Experiments in this field involve activating neurons from the outside and then conditioning the thoughts that the brain produces.

STEFANO PANZERI - COORDINATOR IIT ROVERETO
They are introduced using genetic techniques, tiny switches and proteins which can be activated, i.e. turned on or off, and then turn a neuron on or off by emitting tiny beams of light. In this way, neurons are induced to say what we want them to say.

GIORGIO MOTTOLA
Does this mean you are able to turn neurons on and off at will and let me see what you want?

STEFANO PANZERI - COORDINATOR IIT ROVERETO
Precisely. We can generate a virtual sensation, where the object you want to represent is not actually there.

GIORGIO MOTTOLA OFF-SCREEN
In other words, you make an image, a sensation or an experience seem real even if it is only virtual. These experiments began several years ago and have already had a positive outcome on non-human guinea pigs.

GIORGIO MOTTOLA
But is it possible to induce any kind of thinking, even - I don't know? - a bar of chocolate or an item of clothing?

STEFANO PANZERI - COORDINATOR IIT ROVERETO
In theory, we ought to be able to do so.

GIORGIO MOTTOLA
So you could repeat adverts in a person's brain indefinitely?

STEFANO PANZERI - COORDINATOR IIT ROVERETO
Many US companies are also moving in this direction with huge investments because they think it is useful to develop cognitive functions beyond current levels.

NIELS BIRBAUMER - NEUROSCIENTIST WYSS CENTRE GENEVA
We hope that regulation policies, first and foremost in the United States with the FDA, block this work.

GIORGIO MOTTOLA
In your opinion, should this type of technology stay within the confines of science and medicine?

NIELS BIRBAUMER - NEUROSCIENTIST WYSS CENTRE GENEVA
Brain Computer Interface technology, in my opinion, is even more dangerous than atomic bomb technology.

SIGFRIDO RANUCCI IN THE STUDIO
The Advanced Research Centre of the US Defence Department - the people who devised the internet to highlight how seriously this field is viewed - developed a microchip that can be implanted inside the brain that works rather like a modem and allows communication with external digital devices. It is officially intended for disabled war veterans but it is not impossible to think that someone may give in to the temptation to use it for other purposes. On the other hand, unscrupulous web multinationals are investing heavily in projects that affect the brain, the ability to read and change thoughts. They are the same corporations that have invested in genetics which, when properly addressed, can cure or prevent diseases or even create a selected species. It is an explosive mixture when you combine their capacity for profiling individuals and economic power with the inability of governments to impose restrictions. Even authorities are damp squibs when things have are already been done. Several authoritative philosophers, however, suggest the possibility that a new species is about to be born, that a new human race exists, that the technology is available and as we will see after the adverts there is even no shortage of wierdos around the world.

SIGFRIDO RANUCCI IN THE STUDIO
Welcome back. In the beginning there was the computer, then the laptop, then the tablet and finally the smartphone - and have given them our personal data, emotions, memory and even our identity. We might now be taking the opposite route: digital technology could get inside us. We are about to enter the human cyborg era: an entity half human and half cybernetic. There is already a whole generation of men and women who have already welcomed something artificial into their bodies. Some required pacemakers to be fitted, others inserted silicone breast forms to please themselves or others or simply to make a name on the market. Some people feel that their own bodies and sensations are a prison and free themselves by making them more powerful ... Starting perhaps by connecting the brain to the internet or with the sole power of thought to move an arm that is on the other side of the ocean.

GIORGIO MOTTOLA OFF-SCREEN

In 2005, Kevin Warwick, a university professor of cybernetics, conducted a unique experiment in the world. While sitting in a room at Columbia University in New York, he managed only with the power of thought to move a robotic hand 5 thousand kilometres away in London.

KEVIN WARWICK - PROFESSOR OF CYBERNETICS, UNIVERSITY OF READING
Once I moved my hand in New York, the robotic hand moved after half a second later. And when the robotic hand touched an object, my own nervous system perceived it. My brain effectively felt the robotic hand as if it were my own.

GIORGIO MOTTOLA OFF-SCREEN
This was possible because Professor Warwick was the first man in the world to have become a cyborg. In 2002, he decided to install an electronic device connected to his nervous system inside his arm.

KEVIN WARWICK - PROFESSOR OF CYBERNETICS, UNIVERSITY OF READING
I inserted one hundred electrodes inside my arm which then wirelessly transmitted the signals of my nervous system to the outside.

GIORGIO MOTTOLA OFF-SCREEN
For many people, simply being homo sapiens is no longer enough. The goal is to modify, strengthen and accelerate the course of human evolution.

HANNES SJÖBLAD - BIOHACKER - EPICENTER
For example, eagles have a better eyesight than humans, cats hear better and dogs have a better sense of smell than ours. It's as if we humans lived inside a burqa. This is our sensory universe; Inside it, we try to smell, see, hear and perceive the world, we try to understand the world through our senses but we are locked up inside this prison. How can we escape? The answer is technology.

GIORGIO MOTTOLA
So, its purpose is to overcome the limitations of human nature?

HANNES SJÖBLAD - BIOHACKER - EPICENTER
Expand the human sensory universe: this would be more correct.

GIORGIO MOTTOLA
Do you not think that if nature set us limits, perhaps there is a reason why?

HANNES SJÖBLAD - BIOHACKER - EPICENTER
The biological evolution of mankind had no other purpose beyond survival. Survive for generations and no more. Yet technological evolution means we can decide what human evolution could be like. By applying cybernetics to humans, we can improve our bodies in the same way as we update smartphones.

GIORGIO MOTTOLA
So, the cyborg era is about to start?

HANNES SJÖBLAD - BIOHACKER - EPICENTER
It's already happening.

GIORGIO MOTTOLA OFF-SCREEN

And it is happening to such an extent that many people have followed the example of Professor Warwick. Starting with Neil Harbisson - the first person in history to be recognized as a cyborg by a Western government.

NEIL HARBISSON - CYBORG ARTIST
In 2012, I had problems with the British government because they did not want to allow me to appear in my passport photo wearing an electronic device. I explained to that I do not wear an antenna but have an antenna. Just as I have a nose and eyes, I also have an antenna. After a long legal battle, they finally accepted my explanation and allowed me to appear in my passport photo with the antenna.

GIORGIO MOTTOLA
So, you define yourself as a cyborg?

NEIL HARBISSON - CYBORG ARTIST
Yes, I'm a cyborg because I am not 100 per cent human anymore.

GIORGIO MOTTOLA OFF-SCREEN
Neil suffers from a congenital disease that means he sees the world in black and white. This is why he added this antenna equipped with a sensor that allows his eyes to perceive infrared rays like cats and ultraviolet rays like reindeer.

NEIL HARBISSON - CYBORG ARTIST
This generates a vibration inside my skull based on the light of the colour in turn based on the frequency of colours. When the vibration reaches the skull, it becomes an inner sound. I actually hear specific notes for each colour. When the antenna sees the colour ... then this is the sound of the .... red sofa. This is my pullover ...

GIORGIO MOTTOLA
And this is the sound you hear?

NEIL HARBISSON - CYBORG ARTIST
Yes, more or less.

GIORGIO MOTTOLA
And the antenna is connected to a chip inside your brain?

NEIL HARBISSON - CYBORG ARTIST
The antenna is integrated into the bone. I had holes drilled inside my skull. One houses the chip that vibrates in relation the colours and another has a chip connected to the Internet. So I can receive images and colours from anywhere in the world. While I'm talking to you now I'm also receiving images from Australia.

GIORGIO MOTTOLA
Is your cranium connected to the internet?

NEIL HARBISSON - CYBORG ARTIST
Yes, I have a chip connected to the internet.

GIORGIO MOTTOLA OFF-SCREEN
Neil had the chip implanted clandestinely by doctors and nurses who had to remain anonymous. No hospital today authorises surgery of this kind which is banned by in laws around the world.

GIORGIO MOTTOLA
Do you not find it ethically risky to try to change the course of natural evolution?

NEIL HARBISSON - CYBORG ARTIST
In reality, by becoming a cyborg, I feel much closer to nature and other species. The reality that the antenna allows me to perceive is not virtual reality. I call it revealed reality. Since the technology limits itself to revealing a reality that already exists. Such as ultraviolet and infrared rays, which our species can not see because we do not have the senses to perceive them.

GIORGIO MOTTOLA
So for you, the antenna is a sense.

NEIL HARBISSON - CYBORG ARTIST
Yes, the antenna is a sensory organ that helps me extend my perception of reality.

GIORGIO MOTTOLA OFF-SCREEN
Adding new cyber-senses to the five human senses, in technical terms, is defined as human augmentation. And it is a dream shared by many people today. This is why Neil has set up the Cyborg Foundation and this is its European headquarters in Barcelona. The aim of the Foundation is to defend the rights of cyborgs and to help people become cyborgs. The co-founder is Moon Ribas, a Catalan artist who implanted a new cyber-sense in her ankles.

MOON RIBAS - CYBORG ARTIST
This chip is connected via bluetooth to online seismographs and allows me to feel the earth's seismic activity through vibrations I feel in my feet. So, even though I'm now with you in Barcelona, if there's an earthquake in California or Japan, I feel a vibration inside my body. I call it my seismic sense. I simultaneously I feel the beat of my own heart and the heartbeat of the Earth.

GIORGIO MOTTOLA
And when did you perceive the last earthquake?

MOON RIBAS - CYBORG ARTIST
Not long ago.

GIORGIO MOTTOLA
Was it a strong one?

MOON RIBAS - CYBORG ARTIST
No, it was weak.

GIORGIO MOTTOLA OFF-SCREEN
And it is in this loft that new senses are finalised for human cyborgs. The most recent projects are hanging on the walls.

MOON RIBAS - CYBORG ARTIST
These sensors are fixed to your ears so you can sense the presence of people behind you. This widens perception to 360 degrees. This, on the other hand, is a bluetooth tooth. I have one of these teeth implanted and so does Neil. If I click it, he feels a

vibration inside his mouth and vice versa. Since we both know Morse code, we are able to communicate with each other.

GIORGIO MOTTOLA OFF-SCREEN
This is the latest project realized by the Cyborg Foundation: the cyborg barometer.

GIORGIO MOTTOLA
How does it work?

MANEL MUÑOZ - CYBORG ARTIST
I feel vibrations inside my ears that go up or down depending on atmospheric pressure. And this is a kind of barometric organ, a sensor that senses pressure. I feel high pressure in this ear and low pressure in the other.

GIORGIO MOTTOLA OFF-SCREEN
Kits to become cyborgs can even be purchased online from companies such as Cyborgnest which sells implants to perceive the sense of North.

LIVIU BABITZ - CEO CYBORGNEST
Every time I turn to face North, I feel a vibration inside my body.

GIORGIO MOTTOLA
And where do you feel this vibration?

LIVIU BABITZ - CEO CYBORGNEST
In my chest. This is the sense of North. It comprises two implanted bars of titanium which move in relation to magnetic fields and there is this chip on the outside.

GIORGIO MOTTOLA
The titanium bars are inside you?

LIVIU BABITZ - CEO CYBORGNEST
Yes, inside my chest. You can feel them if you'd like to. Can you feel them? I'll move now to face North.

GIORGIO MOTTOLA
Yes, I felt a vibration. But why not use a compass?

LIVIU BABITZ - CEO CYBORGNEST
Compass are exceptional tools but you have to decide to use one, take it out of your pocket and then put it away again. The sense of North does not ask me if I want to know where North is at any given time. I just know and that's it.

REMO BODEI - PROFESSOR OF PHILOSOPHY UNIVERSITY OF CALIFORNIA IN LOS ANGELES
They are the promoters of this composition of human-artificial intelligence, machines, chips, etc. in the sense of feeling part of a different species. We are a species faced by extinction, those of us who do not have all these devices inside us.

GIORGIO MOTTOLA
So, if we as homo sapiens do not hybridize, we risk extinction.

REMO BODEI - PROFESSOR OF PHILOSOPHY UNIVERSITY OF CALIFORNIA IN LOS ANGELES
We risk being like so-called savages - the term is politically not the most correct - living in the Amazon or Borneo, that is, we are retrograde.

GIORGIO MOTTOLA OFF-SCREEN
But if the cyborgs we have seen so far are for the most part biohackers, activists or simply people trying to revolutionize their relationship with nature, there is also a large international community that has transformed overcoming biological limits and human augmentation into an ideology. It's called transhumanism and has tens of thousands of followers around the world, starting with Silicon Valley in California.

BARBARA HENRY – PROFESSOR OF POLITICAL PHILOSOPHY - SANT'ANNA SCHOOL OF ADVANCED STUDIES, PISA
Transhumanism is unquestionably a dystopian ideology. In other words, an overturned utopia. The most radical dystopias speak of mind uploading. The possibility of transferring a copy of the human mind to software inside hardware that is considered a substitute for the human body. Hence the possibility of imagining that one's mind can be inserted into a microscopic chip that will naturally need a substrate that, however, will no longer be physical, will no longer be bodily, will no longer be mortal.

GIORGIO MOTTOLA OFF-SCREEN
The transhumanist movement has also taken root in Italy for some years. It has its own legal body, the Italian Transhumanist Association, and a national secretary, Stefano Vaj - the transhumanist pseudonym of Milanese lawyer, Stefano Sutti.

STEFANO VAJ - SECRETARY OF THE ITALIAN TRANSHUMANIST ASSOCIATION
It's just like Patty Pravo whose real name is actually Nicoletta Strambelli.

GIORGIO MOTTOLA
It's a pen name, in other words ...

STEFANO VAJ - SECRETARY OF THE ITALIAN TRANSHUMANIST ASSOCIATION
Everyone more or less knows that we are one and the same person but I do not want to be officially
involved.

GIORGIO MOTTOLA
Now then, how many transhumanists are there in Italy?

STEFANO VAJ - SECRETARY OF THE ITALIAN TRANSHUMANIST ASSOCIATION
Several thousand. And I must say that Italian transhumanism has managed to achieve a truly crossways hearing throughout the Italian political spectrum.

GIORGIO MOTTOLA
Ah, so you are involved in politics on a regular basis?

STEFANO VAJ - SECRETARY OF THE ITALIAN TRANSHUMANIST ASSOCIATION
In all settings. We have had members of the Italian transhumanist association or have taken part in debates with people from the left, extreme left, extreme right, centre, centre-left, populism and the establishment.

GIORGIO MOTTOLA OFF-SCREEN
Transhumanist parties have sprung up all over the world and in the United States have even put forwards a presidential candidate during the last elections. Yet in Italy, some fringes of transhumanism seem to be linked with a rather dismal cultural tradition of the past. Stefano Vaj has written an essay with the unequivocal title "For total ethnic defense", where he speaks of racial uniformity, and other texts where he argues that a healthy society is a totalitarian society. The transhumanist lawyer is often at the centre of controversy not the least because of the emblem of his law firm.

GIORGIO MOTTOLA
I also noticed the emblem. It resembles that of the SS.

STEFANO VAJ - SECRETARY OF THE ITALIAN TRANSHUMANIST ASSOCIATION
There was someone else who also said it was a swastika. It may also be, what can I say, a space halberd. We all see what we want to see.

GIORGIO MOTTOLA
In your manifesto you also state that you are ready to take the destiny of the species into your own hands. Do you want to conquer humanity?

STEFANO VAJ - SECRETARY OF THE ITALIAN TRANSHUMANIST ASSOCIATION
We absolutely want to help man become superman. The transhumanist ethic requires it and orders us to reach beyond mankind.

BARBARA HENRY – PROFESSOR OF POLITICAL PHILOSOPHY - SANT'ANNA SCHOOL OF ADVANCED STUDIES, PISA
If you tell me what you're afraid of. Well, I'm afraid of the capillary invasive impact of this transhuman ideology. There are evident traces of eugenics and we must learn to think about this again.

SIGFRIDO RANUCCI IN THE STUDIO
The temptation is to dismiss them as mere madmen but it is the drift of it all that is worrying. Also because while governments forbid it today, what about tomorrow? What if someone were able to influence political choices? The Cambridge Analytica affair teaches us that it is possible. Most of the followers of transhumanism live in Silicon Valley and some of them enjoy top positions in those companies that are investing in technology, web and genetics. If nobody applies a brake, they will be able to dictate the agenda of human evolution undisturbed. And they can even present it all with a certain appeal: using biotechnologies to make us smarter, stronger and longer-lived undoubtedly has its appeal. Except that the first victim of transhumanism could well be equality. Since on the one hand there would be a class of augmented humans and, on the other, normal people. What rights could these augmented creatures claim compared to those left behind? Until now, technologies helped close gaps rather than create new ones. Welfare takes action, even when impaired, to close the gaps between rich and poor, healthy and sick, young and old. Tomorrow, who will it work for? What could be called human and what defined as a machine? You can't reason with a machine, it has no sense of remorse, it has no sense of pity. And the unredeemable difference between man and machine is that we bury our dead.