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Neat Visions.
Glimpses into the Future of Cleaning

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Radical change is one of the characteristics of or times, and it affects all aspects of cleaning. Several fundamental developments transform cleaning tasks, cleaning behaviour and consequently detergents and cleaning tools used: globalization of work and culture, further progresses in all fields of technology, but also ageing of populations in industrialized countries, more flexible and diversified life-styles. From an historian's angle, long-term changes in cleaning culture can be discerned. Social pressure and the demands of hygiene were the main drivers in former times. Today, aesthetic appeal and regulatory requirements have joint practical value. The road leads from "macro-cleanness" via "micro-cleanness" into smaller and smaller dimensions and more complex and specific cleaning tasks as well in household as in professional cleaning and care.

Cleaning – a fascinating topic

Cleaning is a fascinating topic from the technical, the societal, the cultural and last not least the economic perspective. Rather all important trends that have in our age an effect on society exert likewise direct or indirect impacts on cleaning. Several fundamental developments – often called mega-trends – transform cleaning behaviour and the means and tools used, including detergents and their application. Ageing of populations in industrialized countries is giving a push to personal services, and in particular services related to cleaning: flats and furniture, dishes and textiles and last not least persons. The continuous differentiation of life-styles produces - combined with a weakening of social pressures - more diverse personal "cleaning styles" and cleaning habits, covering a wide range from household cleaning experts (or even maniacs) to persons popularly described as "messies" without any idea of cleanliness. Globalization trends in work and culture imply a globalized cleaning culture, following increasingly western models, regardless whether they are in line with the local natural or cultural context. Cleaning, in a way, is a mirror of all society.

In an historical perspective, cleaning has changed throughout the ages. Until the dawn of the industrial age, the worst of the dirt, pests and vermin had to be fought and different cultures as well as different social strata followed their own standards of neatness. Later on social pressure and the demands of hygiene became the main drivers – and microbes the worst scare. Today, aesthetic appeal has joint hygiene, and we increasingly fear invisible contaminations like allergens or air pollutants. What will future scares look like? Will we fight electro-smog, prions, nano-dust? The road leads from cleanness on the macroscopic, visible level ("macro-cleanness") via cleanness on the microscopic level ("micro-cleanness") into smaller and smaller dimensions.

The private consumer's side

In line with the general diversification trend, the supply with means and tools for cleaning is exploding. In parallel, traditional knowledge, handed down in families, about "the right way to get things clean" is eroding, last not least because the experiences of the elder generations are depreciated by innovations. As a result, an average layperson is less and less competent in choosing the right means and in applying them. Even basic knowledge about the nature, the specific utility and possible risks of detergents seems to be in decline. "The more the better" is still for many the implicit guideline – and at the same time expectations about the effect of cleaning agents are rising.

The consumer is faced with a lot of information about the whys and hows of cleaning, but discrepancies abound, and exaggerated promises in advertising result in a feeling of uncertainty, sometimes combined with guilt. Moreover, the tremendous – and still growing – variety of means and brands pushes a part of the consumers into lasting one-sided preferences. Instructions on labels are not sufficient. A way out of this trap are well targeted advisory and other services and generally more education in these matters.

Another important mega-trend is the increasing fragmentation of time: Both work and leisure, all of the daily and yearly routines are split up and sub-divided in ever smaller pieces. This is due, primarily, to increasing mobility and more intense communication. During the industrial age, well defined working hours, fixed times for recreation and for all meals structured day, week, and year. Cleaning had its specific place within these routines with major seasonal and weekly "campaigns". Today, for most persons – struggling to balance work and private life – time slots left for cleaning are fragmented. Similar to "snacking and grazing" in between and in passing, cleaning is done – in the best case – in between and in passing. In the long term, cleaning could well completely lose its anchoring in daily routines.

As time is fragmented and the burdens of everyday life grow (at least in subjective perception), convenience, ease and simplicity are getting more and more important. "Simplify your life" is therefore one of the catchphrases of our times. Convenience implies a reduction: of time spent, of physical work and of organizational efforts. Cleaning has to be quick, easy and effective. Any technology and any service that contributes to that reduction will find its market.

The professional cleaning side

Professional cleaning is an expanding industry that supplies many quite different services to customers ranging from private households to companies and urban authorities, from airports to hospitals. Recently, it has been deeply restructured by facility management. To some extend, professional cleaning is facing at the one hand the same challenges as the individual household one: time slots are narrowing, efficiency is needed, convenience desired. At the other hand, it is much more directly driven by requirements, by restrictions and regulations. A point in case is the EU directive REACh (Registration, Evaluation, Authorisation of Chemicals) that has impacts on the constituents of detergents.

Manufacturing, once main producer of pollutions, is today at the innovative forefront of cleaning with shop floor requirements, clean rooms and clean processes, and increasingly with cycle flow economy concepts. On the whole, it is subject to the same mega-trend from filth to macro-cleanness to micro-cleanness.

Another field of peculiar interest is cleaning in the health sector and more specific of medical instruments. In the last decades, minimal invasive surgery with endoscopic instruments has spread rapidly. Miniaturisation continues, and parallel to it the portfolio of materials

employed expands with titan, tantalum, ceramics, polymers, etc. New surface structures are under development, perhaps in the not too distant future intrinsically clean ones? Does the roadmap lead from micro-surgery to nano-surgery? As information technology shrinks, endoscopic instruments become smart, enhanced by intelligent features, wireless communication, sensors. One may speculate whether there will be a kind of convergence between implantable medical devices, surgical instruments, and analytical devices…

With increasing complexity of instruments, cleaning tasks change. Multiple materials, intricate joints, complex surfaces, and last not least molecular pollutants have to be taken into account. Again, one may speculate whether we will even observe a convergence of cleaning inside and outside the human body or the application of nano-robots for cleaning tasks.

Due to stringent requirements, cleaning of medical instruments is a test-bed for new technologies like ultrasound and new validation procedures to ascertain cleaning success. It can be taken for granted that there will be some technology transfer from medical instruments to other fields of professional care and cleaning and in the end to the household sphere.

New cleaning technologies

There is a multitude of promising technologies that could contribute to higher performance, better compliance to requirements, more efficiency and more convenience in cleaning, in particular nano-technology, robotics and bionics. The household robot, once a cliché vision of science fiction, has finally become real – in the form of tortoise-shaped autonomous vacuum cleaners. Within the next decades, the roadmap leads from simple automata to more complex ones, from single robots to co-operating robots, to swarms of robots of most different sizes and specializations. One could well imagine a whole menagerie of home robots: large floor cleaners, smaller ones for tables and windowsills. Other robots are supplying their colleagues with energy or take the collected dirt from them. This is, at least for the time being, not exactly a vision well rooted to the soil, but progress in robotics, in sensors, actuators etc. is rapid. Things used one day in professional cleaning and care will find their way the next day into the private home, and will also transform the things within the flats. Floors and furniture surfaces and partly the shape of furniture will have to meet the specific demands of robot cleaning. Last not least, cleaning robots will require specific detergents – and use them with extreme efficiency.

Surfaces with lotus-effect are already part of everyday life; nano-structured surfaces will level off the way for new – perhaps robot-based – procedures of cleaning. But nano-technology is not confined to surfaces. Nano-sensors will make it possible to identify all kinds of dirt and pollutions and precisely localize their sources. Household cleaners with active nano-particles will possess absorbing properties tailored to specific substances. And perhaps “nano-dirt” (nano-dust like particulate matter now discussed as air pollutant) will become the next worry after allergens.

The idea of nano-dust suggests filter systems that could be integrated into “bionic buildings”. Such buildings would not only have a lightweight construction after the model of bone structures or diatom skeletons, they should also be provided with functional envelopes that use most different effects – lotus, biocide or hygroscopic effects. Their ventilation and air-conditioning systems – modelled after termites’ nests and supply systems with a leaf-like structure – would have to be equipped with active self-cleaning (and self-healing) functions. Perhaps the floors will no longer be covered by carpets (with their tremendous capacity to collect dust), but by a thin, quasi living layer of cilia that transport dirt particles to specific capturing spots…

Surprises are sure

A look into history teaches us to be cautious. As a rule, technicians are too optimistic about the prospects of their field. During the 1950ies some visionaries dreamed of cleaning a whole room very easily – by watering it with a hose. At latest in 2000 all things in a flat should have a washable plastic surface… And during the 1970ies one imagined washing machines for persons that should not need any water because they would use ultrasound. On the other hand, social scientists are – as a rule – too conservative. They never predicted the rapid adoption of microwave ovens or dishwashers.

For that reason, surprises are sure. The complex interplay of cleaning tasks and cleaning behaviour, of surface structures, of cleaning agents and means and tools makes forecasting difficult. Perhaps, some day we will fight nano-dust by anti-dust-nano-robots? Perhaps, some day cleaning avatars – intelligent software agents with all knowledge about cleaning – will support us? Many questions remain open. But two things are for sure: There will never be a lack of dirt, and cleaning will stay an exciting future issue.