BIOCHEMICAL WEAPONS – A NEW ERA ON BIOTERRORISM?

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Bioterrorism, or rather "the biological threat", has been officially recognized by the White House[1] as one of the top national threats. Consequently, vast resources are focused to research activities that show a promise in countering this particular kind of threat. Its most intriguing characteristic is that it might well change the very fabric of policy, military and society because of its potential to cause unpredictably havoc and mass casualties with little or no detectable preliminaries and means of materialization. There are no obvious "tools of death", nor uniforms or other signs of a perpetrator. Casualties are caused almost silently, without the destructive and obvious side-effect such as heat, overpressure, kinetic energy or even simple mechanical damage. The lethal result, on the other hand, might well be apocalyptic.

The first steps towards this monstrous new world have been taken, although highly evolved biological weapons might have not been as yet developed[2]. Not taking into account the poisoners of ancient, medieval and renesance times, secret services started using bioproducts (usually toxins) for individual elimination purposes during the Cold War. The notorious "Bulgarian umbrella"[3] was perhaps the most celebrated moment. It showed that biopoisons[4] allow minimal quantities to be used for undetectable entrapment of, or delivery to the victim[5]. The effect is secure, retarded and in many cases virtually undetectable, as the factor may elude detection due to nature or quantity or disappears through degradation or post-mortem (residual) metabolism.

The background of such use, coupled to new scientific, industrial and technological developments cause insomniac, when not nightmarish, syndromes to the security community worldwide. Biotoxins are biological products, not living organisms and are thus classified as "biochemical weapons". They are every bit as lethal as conventional weapons, but much more difficult to intercept. They are far more robust, controllable and predictable than the dreadful living biological agents. They are persistent and highly rugged, and so easy to stockpile and difficult to decontaminate when deployed. They can be produced by alternate pathways and improvised methodologies. They are relatively easy to engineer, so as to keep undetectable both the production facilities and equipment procurement traces. They occur in nature, perplexing our procedures of alarm. Since they are present in great variety, they threaten to

create a new, parallel warfighting environment within actual space and time, where non-uniformed and practically untraceable bio-fighters are to clash, with hi-tech but neither visible, nor detectably destructive weapons, for supremacy. At stake will be the survival of hundreds of thousands, the health of millions and the fate of even billions.

Propagators' operating principles

For a variety of reasons permeating less into science and technology and more into actual predisposition (might that be moral, industrial, PR-related military and, most of all, financial) the use of such weapons is more probable in the clandestine operations/ terroristic "black world" than in all-out, open warfare. Unfortunately this all but degrades the danger level: usually, if not always, state actors, no matter how radical, have a feeling of responsibility and also a healthy dosage of sobriety. Such is not the case with terrorism and some covert institutions, because the control procedures are either absent (in the former case) or seriously compromised for the sake of secrecy (in the latter case).

Even within the covert framework, there are some standards to be followed and which may assist the detection of such preparations. An agent must be selected and then collected. The selection part is comparatively easy, can be performed by visits to virtual and real libraries and databases, and is cardinal for the next step. The collection step is trickier, as it entails hunting or cultivating of the producing organism and harvesting the agent. The third step is the application of the agent to a dispersal medium, and the last step is the execution. This four-step procedure sounds primitive and even naïve to most experts. Though, in this lies its strength: It makes away with many other steps, thought of paramount importance in weapons development, such as testing, and thus shortens the fielding time and negates many warning signs to the adversary, signs that testing procedures and feedback mechanisms always provide. Since a terrorist attack, be it state- or non-state sponsored, has a very powerful disruptive parameter, it practically needs not extensive testing and optimal design, planning and delivery. It shall drive home the message and the threat level irrespectively to the actual result.

Asymmetrical threat procedures show well this respect. A new idea is tested freely. If it works, it propagates and becomes a standard. If not, another will be explored. In the meantime, the abortive technique not only has been tested in the best possible simulation (called "reality"), but offers valuable spin-offs: security experts are quick to underestimate the expertise and ingenuity of the propagators, thinking that future attempts would be along the same lines. But the low productivity of the asymmetric arsenal allows a far greater flexibility

altogether, compared to cumbersome, mass-productivity supported conventional forces and agencies. So, the lack of success rather helps the propagator, through the creation of a feeling of laxness and contempt on behalf of the countering officers, which invariably leads to negligence. It is important to remember that a failure does not drop the morale of such propagators, since they are not professionals: they are moved by a cause and they shall do whatever needed, whatever the price[6].

In the biotoxins/ bioregulators field, this creates a host of new problems. Propagators are trying to minimize their losses and avoid casualties if possible, both in human and material resources. Roadside bombs, traps and mining clearly attest to that. But they do not feel restricted by such concerns, as human bombs clearly illustrate. If casualties are needed to achieve their end, or even to accomplish just one, specific mission, they will endure them and they shall find the right culpable. Thus, safety features, handling procedures, self-protection equipment and principles of action, all factors that would usually grant to the opposing forces and agencies some warning (time, information, security leaks and choking points and procedures), do not apply here. Even worse, some agencies tend not to understand the above-mentioned situation, nor its importance.

Internal brewing, resources and recruiting

The sheer scale of possible damage and casualties makes imperative a very resourceful approach, where prevention is the first and foremost step, although not the only, nor the last one. It is a bit reminiscent of the common say “Prevention is better than treatment”, but in here it really IS true. It is not preferable, it is the only way. A toxin attack may fail blatantly, but if not, its impact is definitively strategic, as it allows not only for mass casualties, or the need for evacuation and decontamination of large areas, but it may also focus on heads-of-state and other key individual targets. Usual CBRN first response actions and procedures simply do not apply, as it is a vastly lower grade threat, very difficult to detect. There are no means and procedures able to scan and detect tiny but drastic amounts of biopoisons spread in large area volumes, and things are not much better when considering detestability even in an individual’s blood circulation. Genetic modification may well perplex this effort even more, but this is not the real problem, since biodiversity offers many choices of extremely deadly substances, that are difficult, if not impossible to detect when not searching for each one of them.

As the use of such substances does not really require expensive, high-tech gadgetry (like the aforementioned “Bulgarian umbrella”), especially if the propagators are ignorant of or

indifferent to their escape and even survival, security measures of the conventional sense are ill-advised. There are so many parameters to take into consideration (practically every material which comes into physical contact might be spiked) that the disruptive effect takes place much earlier than the destructive, and even if the latter is nothing but a bluff.

As an example, let's take the use of antidotes: as a standard countermeasure they are out of the question. To administer them, it is imperative to know the agent with a certain, and variable, degree of precision[7]. It could be an option once a propagator standardizes down to a certain –or even a few-bioregulator(s), but this might be a too cooperative adversary for real-life scenario.

It is irritating to notice that the best chance is to negate access to such means and knowledge. It reminds of other eras, where research was prohibited under the penalty of death and proclaimed "witchcraft" and "saucery". It is even worse to remember that, more than anything else, it so happened largely due to the possibility of administering poisons and thus allow an asymmetrical threat against the social fabric to evolve[8]. In any case, as the nucleus of this threat is knowledge of substances, organisms and procedures, it is very obvious were the prevention effort should be focused.

Although much of the actual development and production of toxin and, secondarily, bioregulator weapons can be performed in one's garage[9], the actual know-how is not as widespread. Knowledge may well be accessed in printed publications and in the Internet, but this is far from enough. The skill needed in some cases is minimal, but has to be taught by a knowledgeable person. It becomes obvious that establishments providing such skill become of paramount importance for all implicated parties. Some establishments provide a certain degree of familiarization with procedures, others add knowledge and accessibility of information and yet others allow access to actual hardware, consumables and even strains of organisms. Educational and research facilities are by definition the most prone establishments to such misuse of resources and personnel, especially when legal reasons forbid authorities to monitor sensitive resources and, even worse, provide radical teams of different origins and nature with safe heavens. Even when such groups are benign, the sheer multitude shall lead to a few activist ones which may not resist to such temptations.

But the above is a narrow and simplistic view. Public research and, far more, educational facilities, especially universities and colleges oriented to biosciences and agriculture pose the lower tier of the problem. Non-state, private or other facilities, which depend on grants, programs and every conceivable means of sponsorship and thus diffuse or outright sell their

achievements to their sponsor, pose a much higher danger level. The same is true for the research facilities of corporate entities, which are not controlled by public institutions, due to laws and regulations protecting corporate achievements and patents. The skill and resources available, the level of expertise and the quality of material resources, means and data indicate a much higher threat level in case any infiltration occurs. Not being subject to any public control, dependent for their survival to private, possibly untraceable capital and sharing their findings with their sponsor, who/which may even forestall publication and disclosure, they represent the weakest link of the security effort globally. If resources leaking (materials, methodology, know-how) from a number of such establishments throughout the world are cohesively pooled, in a matter of 6-24 months toxinic and perhaps even bioregulator weapons of usable quality may be produced in dispersed, primitive, well-camouflaged facilities, especially within urban territory. Since access to such high-end resources costs money, for grants, sponsorships, even scholarships and of course for "curtain/cover" establishments (trusts, companies etc) it is certain that only well-organized and financed groups are likely to act in such a way. On the other hand, once such capability is achieved, and since shortage in capital does not plague such a group, the propagation of development and production facilities might be exponential. Within 1-3 years, a globally dispersed production, storage and deployment network is feasible, comprised of many, apartment- or house-sized, almost autonomous, cells.

Shifting Geopolitics

It becomes plainly obvious that a new geopolitical dimension surfaces: the local[10] availability of toxin/ bioregulator sources, so as to be harvested and perhaps processed from the small local dispersed cells. The more austere such facilities are, the nearer, in spatial and procedural sense, the final product has to be. As a result, areas rich in fauna and flora, both macrobiotic and microbiotic[11], become areas of literally strategic importance, a fact antedating their importance for industrial (and especially pharmaceutical) applications. Their importance is also great for intelligence and other secret agencies, but these may depend more on engineered and/or recombinant bioregulators and toxins rather than harvested and processed ones. Such procedures become increasingly feasible as they are information-and capital-intensive, rather than and labor-intensive, as are the discovery, recognition, detection and harvesting of the producer organisms in their natural habitat. Thus, state actors having greater access to information, funding and expertise, might refrain from expeditions in deep jungles and other high biodiversity[12] areas, were new organisms and new bioregulators may be found and known ones may be harvested, planted or hunted. So, more "scientific", naturalistic and ecological excursions will take place in such areas, many of them might well be sinister in

nature[13], and the importance of such areas in the political sphere will rise disproportionately. Moreover, the de facto accessibility of such natural resources means a tendency for more strikes and operations using such agents "locally", as the use is easier near the collection area for groups and propagators with more primitive, non-globalized organization. Collection for second-time and /or out-of-area use is practical only for well-funded and networked groups, state or not, due to the need for transportation and preservation of either the source organism[14] or the collected substance itself.

This tendency might be enhanced by the aforementioned importance of such areas as sources of "raw materials" for this new kind of war, both for attack but also for defense: most antidotes are expected to be found in the same ecosystem and near the habitat of the toxin producer, and are usually produced by species interacting[15] with it.

Short-term countermeasures technology

The minimal number of detectable human symptoms and the limited number of symptoms combinations excludes old-time, symptom-based diagnosis and treatment of victims of biomedical attack. The sheer variety of possible naturally occurring bioregulators might turn the detection of any one used to a tandalian task within the strict timeframes of effective diagnostics. Though, the number, although vast, is also limited and old-fashioned, symptom-based diagnostics might well help in lowering the possibilities a bit, maybe to 5-digit, on condition that the agents are natural-occurring; nether engineered, nor recombinant.

At this point, the high throughput methodologies, developed dynamically in biosciences since 1997, might offer some usable help. Different applications, such as proteomics, metabolomics, toxinomatics[16] etc allow thousands (and even tens of thousands) of one-substance assays to be performed in 2-3 cm^2 of printed microarrays simultaneously and, in some cases, with minimal quantities of sample. There may be two different applications: environmental detection, for surveillance and warning of an attack, and clinical detection, for diagnosis after the attack is performed. The former needs meticulous procedures of sampling and enrichment, so as to detect the agent within many liters of air, water or other substance, where it may be dissolved, diluted or sprayed. The sampling methodology must take into account a variety of possible toxin applications and might benefit from today's forensics sampling techniques and hardware. The latter, the clinical application, is easier as far as sampling procedure is concerned since there is huge biomedical experience in the area, no matter whether the bioregulator is blood-dispersed or not. Of course, the nature of the bioregulator[17] implies sampling peculiarities, and standard techniques and methods might

need a degree of fine-tuning, which could prove difficult and laborious but there is a solid ground, with experience, knowledge and technology from where to begin.

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Notes:

[1] Office of Press Secretary, The White House 28/4/2004.

[2] This is, of course, wishful thinking, as the existence of the Vector program of USSR clearly illustrates and there is no reason to doubt that others of the breed have been initiated throughout the world

[3] Used to execute in 1977 with ricin a Bulgarian national, G Markov, a political refugee in London.

[4] Many poisons are not of biological synthesis, thus "biopoisons" clarifies the origin.

[5] The Markov incident is an example for the latter, the spread of ricin at the door handles of a law enforcement agent in US being the best example of the former.

[6] The failure of the 1993 bombing of the World Trade Center did nothing to discourage a new, more resourceful attempt by the same mastermind.

[7] Else, the use of some antidotes may cause more damage and casualties than the attack itself.

[8] Such dynamics might have changed the whole face of history during the "religious neogenesis" of the 13^{th} –9^{th} centuries BC, then again around 1-3^{rd} centuries AD, where new religions took a world expansion.

[9] In sharp contrast to germ and other biological agents, despite the popular belief to the contrary.

[10] The term "local" is used *sensu latto*, depending not only on distances but also on security checks between harvesting area and the base facility, accessibility of such areas and overall risk/effect and cost/benefit analyses.

[11] Eukaryotic toxins and bioregulators, especially the ones coming from highly evolved multicellular organisms (Metazoa and Metaphyta), are much more effective than bacterial and microbial ones in general.

[12] This is a strategic implication of preserving biodiversity, and perhaps, coupled with similar peaceful biotechnological prospects, the only reasonable one. The ecological view put forward in the subject of biodiversity is ill-founded and more romantic than harmonized with the natural laws of Life on Earth.

[13] From both state and non-state actors, but not in equal proportions. The distribution of collection dynamics and probabilities would vary when taking into consideration these two very different groups of interest.

[14] Plant, animal, microbe.

[15] Through either predatory or symbiotic relations.

[16] Enzymatics, pharmacogenomics and other areas are just as, or even more, useful for antidote detection or engineering.

[17] Skin permeation, inhaled etc