

Editorial: science in drug control

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Science is not obvious, nor is it a “fact factory” producing comprehensive information. It is a systematic approach to knowledge about the material world that progresses by ruling out what is not true. Contrary to the way most people think of science, its purpose is not to amass evidence in support of every critical point in an argument in order to prove truth. In some ways, the accumulation of specific facts is a by-product of science. The true objective of the scientific enterprise is understanding, which comes as much from the intellect as from experience.

Tee L. Guidotti, *Science on the Witness Stand*

Fifty-five years after the first publication was issued as part of a United Nations-led international collaborative scientific research programme in the field of drug control,* the present special issue of the *Bulletin on Narcotics* compiles 13 articles from scientists from around the world, on priority subjects of a scientific and technical nature. It is also the first issue for more than 20 years devoted specifically to the work of drug-testing laboratories. However, unlike the previous issues, published in 1984 and 1985, the present one is not limited to laboratory techniques and analytical results per se, but aims at illustrating the role of drug-testing laboratories and the contribution of science and scientific support to drug control as a whole.

In inviting scientists to contribute to this special issue, a balance has been struck between the various subjects where scientific support and laboratories contribute to drug control and the geographical spread of authors. The present issue of the *Bulletin* reflects those efforts, presenting a unique compilation of articles, written by scientists for an international non-scientific audience of policymakers and other individuals who may, for various reasons, rely on the work of scientists and laboratory findings—often without fully appreciating their

*The breadth of research carried out in a collaborative approach under the United Nations opium research programme by scientists from around the world is reflected in the United Nations document series ST/SOA/SER.K, entitled “The assay, characterization, composition and origin of opium”. Over a period of 17 years, a total of 148 research papers were published, the first one in 1951; that first paper, referred to here, was entitled “The determination of morphine in opium by extraction: a new method”.

value and limitations. The main aim of this issue is therefore to raise forensic awareness outside the laboratory, bridging the gap between the highly technical work of scientists and their results and the needs and expectations of the users of laboratory data and information.

Science is not a “fact factory” producing comprehensive information. Laboratories produce results, and they need to have access to, and apply, quality standards to produce them, but those results also have to be turned into information and knowledge. Despite all technological advances, and contrary to popular belief, this does not happen automatically, and the interpretation and integration of results, and their communication, in the form of findings and information relevant to the end-user, remain key areas of the work of a scientist.

Several articles in this issue of the *Bulletin* present pure research findings, while others provide summarized data or information on specific aspects (on-site testing, drugs and driving and so on). Articles are organized in the areas of drug production, drug trafficking and interdiction, and drug abuse, illustrating the critical role of the scientist and the laboratory as a resource for the entire range of drug control efforts. They include, for example, scientific contributions for law enforcement operational work (i.e. in the context of intelligence-led law enforcement), prevention (e.g. early warning systems), regulatory and monitoring purposes and policy development.

The result is that this special issue contains papers covering a wide range of subjects and considerable variation with regard to the type of scientific support, substances discussed and analytical methods employed. Articles are exemplary for the work of thousands of scientists around the world, who, day by day, carry out their work, making a critical contribution to reducing drug abuse worldwide.

Despite their central role in drug control, forensic laboratories are usually seen and used as tools and servants rather than as resources and partners. At best, the value of individual laboratory results to answer a specific question, to save a life, to help in treatment or to identify or confirm a crime is recognized. However, there is much less recognition of the fact that collectively, as a body of information, laboratory results also constitute a valuable commodity in their own right by helping to identify new potential threats and health hazards, especially those related to new drugs and manufacturing methods, new sources of drugs and drug availability, new purities and cutting agents, and new products and drug combinations.

Further, forensic drug-testing work is rarely considered revolutionary (assessed in lay terms) and is often without direct visible successes, because it is the law enforcement officers who celebrate the multi-kilogram seizure of a given drug, confirmed in identity by a laboratory; or it is the policymakers who introduce restrictions on the availability of a dependence-producing medicine or place another drug or precursor under regulatory control, only after the prevalence of the substance has been identified with the help of a laboratory.

Nevertheless, there are exceptions. A recent example from the international scientific literature, which has created significant interest among policymakers,

is an Italian study on the use of cocaine concentrations in surface waters as a new evidence-based tool to monitor community drug abuse.* Although this approach, which has since been repeated in other European countries, may currently be limited to technologically advanced countries (considering the required instrumentation, expertise and costs), it has the potential to become a standardized, objective and independent tool for monitoring drug abuse.

In general, there is a need for wider recognition of the added value of an integrated national scientific support service as an equal partner with law enforcement, judicial, regulatory and health authorities. Laboratories need to be provided with the resources they require to sustain high-quality services, and they and their scientists need to be given the opportunity to participate actively in relevant regional and global networks of forensic scientists to exchange experience and analytical findings at an early stage. Most importantly, national institutions and government agencies need to be made more aware of the range of work and possibilities of scientific support to ensure better use of available laboratory resources and greater recognition of the potential value of scientific information, beyond the use of laboratory results as evidence in court.

The present special issue is a small contribution towards that goal, and the United Nations Office on Drugs and Crime (UNODC) hopes that it will contribute to increasing appreciation for the excellent work carried out by countless scientists around the world, thriving to deliver quality findings, often with only basic equipment, but with vast experience, good scientific judgement, and great affection for their job. These scientists deliver excellent, reliable data, thus countering the belief frequently held by non-scientists (policymakers and other users of laboratory results) that the level of sophistication of a laboratory is a direct measure of the quality of the scientific support delivered. That this belief is a severe misconception can be easily demonstrated, and there are numerous examples highlighting the importance of experience and good scientific judgement (i.e. the human input), especially in the interpretation and communication of results.

It is hoped that this special issue of the *Bulletin* will also contribute to renewing the spirit of earlier collaborative scientific research programmes coordinated by the United Nations,** which proved that scientific and technical problems in the field of drug control can most effectively be dealt with at the international level. The list of subjects that would benefit from a collective, international, scientific effort is long; it includes the production of more systematic information on the purity of drugs (or: the potency of cannabis products); new drug products and combinations and their potential health hazards; the yield of drugs such as cocaine, opium and heroin from illicit drug operations;

*Ettore Zuccato and others, "Cocaine in surface waters: a new evidence-based tool to monitor community drug abuse", *Environmental Health: a Global Access Science Source*, vol. 4, No. 14 (2005).

**In addition to the opium research programme, there also were scientific research programmes on cannabis (1959-1979), on *Papaver bracteatum* research to increase codeine production (1972-1983) and on the chemical composition of khat (1971-1979). More recently, activities have focused on drug characterization/impurity profiling as a scientific tool in support of drug control activities (since 1996).

trafficking routes and drug sources; the effects and implications for different environments of chemical waste from illicit drug processing and manufacture; and the extent and implications of the abuse of traditional and herbal drugs—to name but a few.

Finally, UNODC wishes to acknowledge that many authors contributed their articles in addition to a heavy, routine workload and that several of them had to write in a language that is not their mother tongue. That added difficulty is specifically acknowledged.

Overview: contents

The 13 articles submitted for this special issue of the *Bulletin* are grouped into four sections: drug production; drug trafficking and interdiction; drug abuse; and a general section illustrating the role of, and efforts to maintain, quality assurance systems as an overarching element and integral part of modern laboratory management. What all articles have in common is that they illustrate the important role of the scientist, his or her informed judgement and expertise in turning analytical results into information and knowledge into a commodity useful to their “customers”, who include personnel in law enforcement, health or regulatory authorities and the judicial system.

Section I. Drug production

Articles in section I illustrate the role and potential of laboratories (and science in general) in assessing the extent of drug production and identifying trends in clandestine processing or manufacturing methods and chemicals used. They range from the documentation of an “experimental” heroin manufacturing process in Afghanistan and the presentation of scientific tools that help assess methods used for the manufacture of illicit synthetic drugs, link precursors to end products and identify sources of starting materials, to studies of tetrahydrocannabinol (THC) content and other technical aspects related to the illicit cultivation of cannabis plants in Morocco.

The first article, by Zerell and others (“Documentation of a heroin manufacturing process in Afghanistan”), provides first-hand information on a heroin manufacturing process carried out under controlled conditions in Afghanistan. A number of policy-relevant findings emerged, namely with regard to the type and quality of the resulting heroin product, the simplicity of the process employed and the quantity of solvents used. The article thus represents a valuable source of information, in particular for regulatory and operational law enforcement personnel, on the quality and quantity of heroin that may be illicitly manufactured in Afghanistan and the required chemical input.

The article by Krawczyk and others (“Impurity profiling/comparative analyses of samples of 1-phenyl-2-propanone”) is the result of the joint efforts of forensic scientists and their colleagues in law enforcement. It describes the development of a system for the impurity profiling of 1-phenyl-2-propanone (P-2-P)

(also known as benzyl methyl ketone (BMK)), a key precursor in clandestine amphetamine manufacture. The authors highlight the usefulness of the system in determining P-2-P manufacturing routes and identify samples from the same illicit source. Of particular note is the view expressed by the authors of the importance of a good working relationship and interaction between the law enforcement and forensic sectors as part of effective interdiction.

In another article, Makino and others present an approach to discriminating the manufacturing origin of ephedrine, the key precursor used in the clandestine manufacture of methamphetamine (“Investigation of the origin of ephedrine and methamphetamine by stable isotope ratio mass spectrometry: a Japanese experience”). The beauty of the approach is that the origin of the starting material, ephedrine, might be deduced from the analysis of the end product, methamphetamine. While the authors acknowledge that further refinement of the approach is required, including the examination of authentic sample material from a larger number of known manufacturing origins, the technique has already attracted interest from regulatory authorities in Japan and elsewhere, with regard to providing an independent means of determining origin, especially of precursors.

Finally, Stambouli and others analysed samples of fresh, dry and powdered cannabis herb obtained as part of a survey on the cultivation of cannabis plants in Morocco (“Cultivation of *Cannabis sativa* L. in northern Morocco”). Their work constitutes an important contribution to overall estimates of cannabis production by making available for the first time analytical data on the THC content (potency) of different cannabis products from Morocco obtained under controlled conditions. This contribution is particularly important in the context of ongoing discussions about the increasing THC content of cannabis samples.

Section II. Drug trafficking and interdiction

The common trait of articles in section II is the use of the presence of impurities in illicit drug samples—be they manufacturing by-products, residual solvents from the manufacturing process or trace metals—to establish possible links between samples and identify their sources. Such types of comparative analysis, which are not limited to drug trafficking and interdiction cases, are typically known as drug characterization/impurity profiling studies. Several of the articles in this issue of the *Bulletin* discuss details of that approach for a variety of different purposes and in their respective national contexts (see also the article by Krawczyk and others referred to above). An important conclusion drawn by most of the authors is the need for an integrated, operational programme that ensures two-way communication between the laboratory and law enforcement personnel and the timely follow-up of analytical results.

The first article in this section, by Ioset and others (“Establishment of an operational system for drug profiling: a Swiss experience”), presents a comprehensive outline of the establishment of an operational system for heroin profiling. Among the many purposes for which impurity profiling programmes might

be established, the focus by Ioset and others is on improving knowledge of the illicit heroin market and drug distribution patterns, with the operational goal of devising appropriate medium- and long-term intervention strategies. Technical aspects of analytical methods and statistical and chemometric methods are presented. The framework within which such comparative analyses are carried out is also discussed, highlighting the importance of following an integrated and standardized approach at the national level, as well as at the regional and international levels.

Hung and others describe the evolution of comparative analyses and profiling activities in Viet Nam (“Drug profiling: a new scientific contribution to law enforcement operations in Viet Nam”), based on a need to understand the pattern of heroin and methamphetamine manufacture and distribution in the region. While the establishment of a comprehensive profiling programme is still in progress, the authors present some findings from the analysis of seized heroin and methamphetamine and discuss the results from an operational point of view. This article should be seen as encouragement for all those scientific services around the world which may be faced with resource limitations, because it shows that operationally useful results can be obtained using a simple combination of a few physical characteristics of samples, such as colour and packaging material, and chemical analysis of key components.

The article by Visser and others (“Residual solvents in methylenedioxymethamphetamine tablets as a source of strategic information and as a tool for comparative analysis: the development and application of a static head-space gas chromatography/mass spectrometry method”) outlines the development of a specific sub-type of profiling method targeting solvent residues trapped in the drug during the final crystallization step. While the authors conclude that this method, after further refinement, might become part of a strategy for comparative analysis, its immediate value lies in the identification of solvents used in the illicit manufacture of methylenedioxymethamphetamine, thus contributing to decisions on the monitoring and control of such substances.

The last article in section II, by Çopur and others (“Determination of inorganic elements in poppy straw by scanning electron microscopy with energy dispersive spectrometry as a means of ascertaining origin”), explores the potential of using inorganic element profiles of poppy straw for monitoring licit opium poppy cultivation and poppy straw production in Turkey and for distinguishing them from illicitly produced poppy straw or poppy straw trafficked from abroad. Again, while the analytical approach is not new, its novel application provides comparative data that could be of interest to law enforcement and regulatory authorities alike.

Section III. Drug abuse

Articles in section III address the role and challenges of drug testing when biological materials (urine, blood etc.) are involved and especially of on-site testing, for example, in connection with cases involving drugs and driving.

Toxicological analysis is also an important element in epidemiological research, as part of early warning programmes by means of which results can provide important evidence of new drug trends to be acted on by health authorities and in support of scheduling decisions.

The opening article by Drummer (“On-site drug testing”) provides an overview of the concepts, applications and quality and cost considerations of on-site drug testing. The review is important because applications for non-laboratory-based techniques are increasing in number and range, for example, as part of workplace and roadside testing programmes, for the monitoring of compliance in drug courts and other treatment programmes or for testing inmates in prisons and other correctional institutions. Recognizing and appreciating not only the advantages but also the limitations of available on-site testing devices guarantees their responsible use in an ever-broadening field of applications, affecting the lives of an increasing number of individuals.

Lillsunde and Gunnar (“Drugs and driving: the Finnish perspective”) describe the approach to handling roadside testing and cases involving drugs and driving in Finland. Importantly, they outline the implications of the prevailing types of legislation (“zero-tolerance” and “impairment” laws) for successful prosecution of cases involving drugs and driving, either by proving the presence of a zero-tolerance drug (or its metabolite) in the driver’s blood, or by proving “impairment” of driving ability in court. This issue is still being debated in many countries.

Chung (“Role of drug testing as an early warning programme: the experience of the Republic of Korea”) describes the use of drug testing as part of a national programme to monitor the abuse of common medicines. While the article focuses on the specifics of the situation in the Republic of Korea, it exemplifies the challenges faced by drug-testing laboratories that provide analytical services for early warning programmes, namely, the need to identify what could potentially be any one of a huge number of drugs of abuse or poisons and to develop suitable, reliable and specific methods of detection.

The article by Chan and others (“Psychoactive plant abuse: the identification of mitragynine in ketum and in ketum preparations”) outlines the central role of drug testing in an approach to controlling the abuse of a traditional drug in Malaysia. It reminds the reader that drug-testing laboratories in different parts of the world must be able to analyse a wide range of drugs, which are frequently not listed in the international drug control conventions and for which they may need to develop suitable analytical methods.

Section IV. Quality management in laboratories

The article by Salas and others (“Quality management systems and the admissibility of scientific evidence: the Costa Rican experience”), the last in this special issue, gives some insight into the meticulous and responsible work of laboratories, which underpins the contribution of drug testing in general and the quality of its results specifically. While the article describes the Costa Rican

experience, it is exemplary regarding the establishment of quality systems, outlining the resource requirements and the range of activities carried out and maintained continuously “behind the scenes”. As noted above in connection with the analytical work of scientists and forensic laboratories in general, those systems constitute another key aspect of forensic laboratory work that is without any visible output but is essential to the delivery of quality results and services.

Drug-testing laboratories exist around the world. They often function under difficult conditions and with limited resources. Through the publication of this set of 13 thematically related but wide-ranging articles on science in drug control, it is hoped that this special issue of the *Bulletin* will contribute to improving those conditions by raising forensic awareness and stimulating the increased use and enhanced integration of drug-testing laboratories at the national level in all relevant drug control efforts, including policy development.