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Illicitly Imported Heroin* Products: Some Physical and Chemical Features Indicative of Their Origin. Part II

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ABSTRACT: Samples taken from seizures of imported illicit heroin preparations of known geographical origin have been examined. The typology developed in a previous survey of illicit heroin products is applicable to virtually all the samples studied in this work. On the basis of these observations it is possible to give an opinion as to the origin of some samples of illicit heroin of unknown provenance. The observation in the previous survey that unrelated samples of illicit heroin possess unique chemical profiles has been confirmed by the present results.

KEYWORDS: toxicology, heroin, chromatographic analysis

Several chemical studies have been made of opium and poppy straw and the narcotic content was found to vary with batch and origin [*1-3*]. Attempts have been made to relate the chemical profile of opium to its geographical origin [*4*]. However, the composition of opium is believed to vary, even within a given location, as a result of natural phenomena and the conditions under which the latex is harvested.[2] Even so, a given batch of heroin, which may be typically 15 kg [*5*], will give rise to a characteristic chemical profile even though it may have been prepared from several batches of opium. The end product of powdered heroin will be homogeneous, at least immediately after its preparation, although differing storage conditions of separated aliquots may lead to chemical differences developing. The addition of diluents, although altering the absolute composition, will not affect the relative amounts of the various narcotics present. An excess of diluents may, however, make comparison with unadulterated heroin difficult. It is highly probable that different batches of heroin, even from the same source, will have different chemical profiles. To adduce some evidence for these deductions, we have examined a large number of different seizures of illicit heroin, which were, to the best of our knowledge, unrelated. We have also examined a number of packages of heroin known to be from a given importation and therefore possibly from a single manufacturing batch.

In a previous paper [*6*] the physical appearance and chemical composition of over 200 samples of illicit heroin of authenticated origin seized at points of entry into the United Kingdom were given. It was found that particular geographical regions produced characteristic illicit heroin products and it is therefore possible to assign likely origins to illicit heroin samples of

*In this paper "heroin" means pure diacetylmorphine. "Illicit heroin" means impure diacetylmorphine that contains related narcotics and other materials and is of clandestine origin.

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unknown provenance. In the present paper the findings obtained on a further 215 samples of illicit heroin of authenticated origin seized at airports and seaports in the United Kingdom are given and the conclusions of the study compared with those drawn in the earlier work.

Experimental Procedure

The procedure adopted for taking representative samples of illicit heroin was as described in our previous paper. The samples in this study were collected over the period November 1982 to December 1983 and represent virtually all illicit heroin seized by Officers of Her Majesty's Customs and Excise at importation into the United Kingdom during that period. Assignment of the most probable country of origin was based on the criteria previously specified.

Excellent agreement was achieved between the gas liquid chromatographic and high performance liquid chromatographic results for the vast majority of the samples in the previous survey. Samples in this survey have therefore been subjected only to high performance liquid chromatographic analysis. In cases where the resulting chromatograms indicated the presence of compounds in addition to the narcotics under study, the samples were then analysed by gas chromatography—mass spectrometry uniquely to identify and, if necessary, quantify the extra components. All samples had previously been subjected to both infrared spectroscopy and thin-layer chromatography, as part of their routine forensic science examination. Pure authentic compounds were again examined by the standard gas liquid chromatographic and high performance liquid chromatographic systems to confirm retention data.

Preparation of solutions for analysis, the instrumentation, operating conditions, and assignment of color were all as described in the previous work [*6*].

Results

Qualitative and quantitative results for each sample taken from unrelated seizures are given in Tables 1 to 6 and are presented chronologically in order of seizure, for each originating country.

Physical Appearance

South East Asian (Table 1)—No "Chinese No. 3" type heroin has been encountered in this survey, this type being superceded by the product known as "Penang Pink." Apart from color, this occurs in the shape and form of "Chinese No. 3" described in the previous survey. All the other samples from Southeast (SE) Asia conform exactly to the physical appearance of the type known as "Chinese No. 4" and described in our previous paper.

Indian (Table 2)—Two samples were fine white odorless powders, the others as described in the previous paper.

Pakistani (Table 3)—Two types:

1. Samples, where the narcotics were present as free bases, were encountered in virtually every shade from beige to dark brown. However, the great majority of samples were light brown with a strong characteristic odor. One sample (Reference 385) was a fine white, virtually odorless powder. The product was much more consistent than in the previous survey, nearly all samples being a fine dry powder with a few soft aggregates.
2. Samples where the narcotics were present as hydrochloride salts were white or off-white fine dry powders, which were usually odorless.

Turkish (Table 4)—Fine light brown dry powders without aggregation.

Iranian (Table 5)—The single example was typical of the product described in the previous paper.

Nigerian (Table 6)—The single example was a fine pale beige-colored powder.

TABLE 1—*Results of analysis of illicit heroin of SE Asian origin.*[a]

No	H	AC	6AM	N	P	Form	Col	Other Observations
						THAILAND		
463	88.1	4.9	4.9	ND	ND	HCl	white	
464	75.1	8.8	1.6	ND	ND	HCl	white	
465	80.5	5.8	0.7	ND	ND	HCl	white	
466	62.3	4.1	2.9	ND	ND	HCl	4A2	
467	77.4	7.9	0.5	t	t	HCl	white	
468	61.9	6.4	0.9	t	t	HCl	white	
						SINGAPORE		
469	81.9	5.6	2.4	ND	ND	base	5A2	
						HONG KONG		
470	80.4	7.8	2.9	ND	ND	base	white	
						"PENANG PINK"		
471	49.0	11.1	2.0	ND	ND	HCl	7A3	
472	17.9	3.9	5.3	ND	ND	HCl	7B2	

[a]Abbreviations:

No	heroin sample serial number
H	diacetylmorphine
AC	acetylcodeine
6AM	6-acetylmorphine
N	noscapine
P	papaverine
Form	base or hydrochloride salt
Col	color, as defined in the *Methuen Handbook of Colour*, Eyre Methuen, London, 1978.
ND	not detected, detection limit 0.3%
t	trace amount present

All figures represent the percentage composition with respect to the total weight of sample.

TABLE 2—*Results of analysis of illicit heroin of Indian origin.*[a]

No	H	AC	6AM	N	P	Form	Col	Other Observations
447	57.8	6.1	1.6	t	t	HCl	5A2	
448	74.0	3.6	1.1	t	t	HCl	4A2	
450	67.6	2.2	4.3	t	t	HCl	4A2	
451	75.0	1.2	1.0	t	t	HCl	white	
452	4.5	2.5	41.9	t	t	HCl	4A2	chemically unstable
453	72.8	5.3	0.6	t	t	HCl	white	
454	66.7	1.9	2.5	t	t	HCl	4A2	
455	60.7	5.3	3.3	6	3	base	5E7	

[a]Abbreviations:

No	heroin sample serial number
H	diacetylmorphine
AC	acetylcodeine
6AM	6-acetylmorphine
N	noscapine
P	papaverine
Form	base or hydrochloride salt
Col	color, as defined in the *Methuen Handbook of Colour*, Eyre Methuen, London, 1978.
t	trace amount present

All figures represent the percentage composition with respect to the total weight of sample.

TABLE 3—*Results of analysis of illicit heroin of Pakistani origin.*[a]

No	H	AC	6AM	N	P	Form	Col	Other Observations
301	79.0	6.0	1.9	t	t	base	5D4	
302	71.4	7.5	2.4	3	3	base	5D4	
303	64.5	4.1	0.5	2	3	base	5D4	
304	70.2	5.1	2.1	*	*	base	5D4	
305	57.0	2.1	4.4	t	t	HCl	4A3	
306	74.0	6.5	1.5	*	*	base	5C4	
307	73.5	7.4	1.9	*	*	base	5D4	
308	72.4	6.8	2.0	6	5	base	5C4	
309	77.5	6.1	2.7	4	4	base	5D4	
310	80.5	5.0	0.6	3	4	base	5D5	
311	77.2	1.7	3.5	t	t	HCl	4A2	
312	67.1	4.3	1.0	9	5	base	5C4	
313	68.5	6.8	3.1	4	4	base	5D5	
314	73.1	6.8	2.4	5	5	base	5D4	
315	68.6	5.0	0.7	16	2	base	5C4	
316	74.8	7.0	0.8	6	2	base	5D4	
317	70.5	7.3	2.4	6	4	base	5D5	
318	69.0	6.9	2.4	t	t	base	5D5	
319	77.9	1.8	3.9	t	t	HCl	4A3	
320	80.1	2.1	2.8	t	t	HCl	4A3	
321	80.2	1.8	3.0	t	t	HCl	4A2	
322	62.0	5.0	0.9	18	4	base	5D4	
323	46.9	3.5	1.8	13	3	base	6F5	
324	48.9	3.6	2.7	14	3	base	6E4	
325	77.1	1.5	4.8	t	t	HCl	5B2	
326	72.7	7.3	5.1	3	3	base	5D5	
327	70.8	7.6	2.2	8	4	base	5D4	
328	79.3	8.6	1.6	5	4	base	5C4	
329	41.4	5.3	18.7	t	t	HCl	4B4	
330	77.7	9.6	3.1	4	3	base	5D4	
331	82.0	0.8	1.5	t	t	HCl	5B1	
332	73.7	6.5	2.4	6	5	base	5D4	
333	66.1	7.9	3.3	5	4	base	5D4	
334	74.9	6.3	1.2	5	4	base	5D4	
335	76.6	6.6	1.1	5	4	base	5D4	
336	66.1	4.7	1.0	3	4	base	5D4	
337	76.3	1.4	3.0	t	t	HCl	4A2	
338	70.2	6.5	1.0	6	4	base	5D4	
339	56.7	6.4	7.2	5	4	base	5F8	
340	67.4	6.6	5.0	2	3	base	5E5	
341	71.3	5.7	0.9	6	6	base	5D4	
342	73.2	6.1	1.1	5	5	base	5D4	
343	77.2	6.4	1.8	3	7	base	5E4	
344	83.7	5.5	0.6	t	t	HCl	white	
345	74.2	5.8	1.2	8	6	base	5D4	
346	68.5	6.3	3.0	5	5	base	5D4	
347	78.0	6.0	2.2	5	5	base	5D4	
348	76.8	5.4	1.5	8	5	base	5D4	
349	76.4	6.9	1.5	6	5	base	5C4	
350	25.0	2.0	35.0	ND	ND	tartrate	5B2	
351	80.2	1.4	1.5	t	t	HCl	white	
352	75.5	6.4	2.2	6	5	base	5D4	
353	74.5	6.0	2.0	6	7	base	5D4	
354	79.0	6.3	1.0	4	2	base	5C3	
355	72.3	6.5	2.0	4	6	base	5D4	
356	59.3	3.1	5.2	t	t	base	5C3	
357	72.9	6.5	1.8	4	5	base	5D4	
358	70.4	6.0	2.8	5	6	base	5E8	
359	87.2	6.5	1.1	t	t	base	5B3	
360	63.2	4.2	0.7	t	t	base	4A2	

TABLE 3—*(continued)*

No	H	AC	6AM	N	P	Form	Col	Other Observations
361	70.9	6.1	1.2	7	5	base	5D4	
362	73.0	5.6	1.2	6	5	base	5D4	
363	82.7	7.0	1.2	3	4	base	5C3	
364	87.7	1.7	1.6	t	t	HCl	white	
365	83.7	6.6	1.0	1	2	base	5B2	
366	70.1	5.6	2.3	4	7	base	5E8	
367	75.4	5.2	1.2	4	4	base	5D4	
368	68.3	5.4	1.1	7	4	base	5D4	
369	65.6	4.5	0.9	18	5	base	5D4	
370	67.8	2.0	3.5	t	t	HCl	4C3	
371	82.1	2.6	3.6	t	t	HCl	white	
372	83.0	2.2	2.9	t	t	HCl	4A2	
373	81.2	6.7	1.9	t	t	base	5B3	
374	74.3	6.2	1.3	5	5	base	5D4	
375	81.9	5.6	1.2	t	t	base	4A2	
376	78.8	5.6	2.3	5	2	base	5C3	
377	53.5	1.4	2.8	t	t	HCl	white	
378	78.4	4.6	2.1	7	3	base	5C3	
379	78.7	4.1	1.9	7	3	base	5D4	
380	70.0	4.3	2.7	10	5	base	5D4	
381	49.5	1.0	4.0	t	t	HCl	white	
382	82.7	ND	2.0	t	t	HCl	white	
383	84.0	4.2	0.5	10	2	base	4A2	meconin — ?
384	74.2	4.5	1.4	10	5	base	5D4	
385	45.3	2.7	0.6	t	t	base	white	
386	71.4	5.5	0.8	15	4	base	5C3	meconin — ?
387	53.1	3.3	0.8	3	6	base	4A3	
388	63.1	4.5	1.3	16	4	base	5C3	
389	75.0	6.0	2.5	4	3	base	5D4	
390	63.3	6.7	2.2	9	5	base	5D4	
391	67.4	1.3	2.4	t	t	HCl	5A2	
392	67.7	5.1	0.9	15	6	base	5C3	
393	82.9	0.9	1.5	t	t	HCl	5B2	
394	80.5	1.0	1.2	t	t	HCl	5B2	
395	67.3	6.0	1.7	13	6	base	5E5	
396	63.7	6.3	1.7	16	7	base	5D4	
397	73.7	6.7	1.7	10	5	base	5C3	
398	60.8	6.0	3.7	16	6	base	5F8	
399	64.2	5.9	1.1	17	7	base	5D4	
400	64.6	5.5	1.0	20	7	base	5C3	
401	60.3	7.3	1.2	21	8	base	5D6	
402	65.8	5.7	1.3	14	7	base	5D4	
403	65.3	5.5	1.5	16	6	base	5D4	
404	64.9	6.2	1.3	15	6	base	5D4	
405	56.0	6.1	2.3	19	6	base	5D4	
406	65.7	5.5	1.5	19	6	base	5D4	
407	73.0	9.7	2.4	6	4	base	5D4	
408	69.2	9.1	4.4	2	9	base	5D6	
409	69.7	11.1	3.3	5	5	base	5D4	
410	79.4	7.8	2.4	5	5	base	5D5	
411	60.1	5.2	1.3	19	5	base	5D4	
412	47.9	1.6	3.4	t	t	HCl	white	
413	66.9	5.0	0.3	20	7	base	5D4	
414	60.1	5.7	2.0	13	10	base	5D4	
415	61.6	4.7	0.6	18	9	base	5C3	
416	75.4	6.7	3.3	6	5	base	5E6	
417	61.2	3.1	1.5	9	3	base	6E4	
418	48.7	4.8	2.2	26	12	base	5D4	
419	63.6	6.8	2.6	14	7	base	5D4	
420	63.1	3.9	2.2	17	8	base	5C3	

TABLE 3—*(continued)*

No	H	AC	6AM	N	P	Form	Col	Other Observations
421	65.3	4.5	2.4	14	6	base	5D4	
422	49.1	3.7	2.3	10	4	base	5D6	
423	68.3	5.5	1.8	11	5	base	5D5	
424	44.1	4.3	1.4	13	5	base	5D4	
425	60.6	5.4	0.7	17	6	base	5D4	
426	73.6	2.9	2.9	t	t	HCl	5B2	
427	45.9	4.9	0.9	10	3	base	5C3	
428	78.2	7.2	0.5	9	3	base	5B2	
429	80.3	5.0	0.4	7	3	base	5B2	
430	61.9	5.0	1.3	18	5	base	5C3	
431	66.3	5.5	1.6	4	4	base	5D4	
432	60.7	8.4	1.4	12	6	base	5D4	
433	66.7	4.4	1.5	18	5	base	5D4	
434	59.6	3.9	1.8	15	5	base	5D4	
435	57.8	2.5	1.0	15	6	base	5C3	
436	53.9	2.4	1.4	18	10	base	5D4	
437	58.5	2.5	1.5	21	10	base	5D4	
438	61.1	2.7	1.6	16	8	base	5D4	
439	51.1	2.2	1.3	17	9	base	5D3	
440	63.8	2.6	0.9	14	6	base	5D3	
441	68.8	2.9	2.2	8	16	base	5D4	
442	55.9	4.6	1.6	29	7	base	5D4	
443	78.4	1.7	4.0	t	t	HCl	white	
444	64.7	5.0	0.3	11	3	base	5C3	
445	68.2	4.3	0.8	18	5	base	5C3	
446	66.2	4.9	1.2	18	5	base	5C3	

[a]Abbreviations:

No	heroin sample serial number
H	diacetylmorphine
AC	acetylcodeine
6AM	6-acetylmorphine
N	noscapine
P	papaverine
Form	base or salt
Col	color, as defined in the *Methuen Handbook of Colour*, Eyre Methuen, London, 1978.
ND	not detected, detection limit 0.3%
t	trace amount present
*	present but not quantified

All figures represent the percentage composition with respect to the total weight of sample.

Chemical Composition

As in our previous survey, the chromatographic data produced in this work show that specific countries or regions produce characteristic, but not necessarily unique, illicit heroin products. Examination of the present results shows that the types identified in the previous work account for virtually all the samples examined in this study. However, a few trends have been discerned, and there is one new and distinct product.

Only a small proportion of seizures originated from Southeast Asia and, in contrast to the previous study, there were no occurrences of "Chinese No. 3" heroin. However, the chemical profile of "Chinese No. 3" is virtually identical to that of "Penang Pink," the latter is merely "Chinese No. 3" with the addition of a small quantity of a red dye (Table 7). Although "Penang Pink" is a well-known variety of illicit heroin, it had not been encountered in the United Kingdom, at least in recent years, until the present survey. The high purity samples of

TABLE 4—*Results of analysis of illicit heroin of Turkish origin.*[a]

No	H	AC	6AM	N	P	Form	Col	Other Observations
456	13.4	0.9	1.4	ND	ND	HCl	5B3	procaine = 24%
457	54.3	3.8	2.9	3	2	base	5B3	
458	41.1	4.7	5.4	3	26	HCl	5E8	caffeine = ?%
459	86.3	7.1	0.7	4	3	base	5D5	
460	64.2	5.4	0.4	4	3	base	5D4	procaine = 10%, calcium carbonate = 18%
461	78.7	6.0	0.6	3	5	base	5C4	
462	74.2	4.7	0.9	5	3	base	5C3	

[a]Abbreviations:

No heroin sample serial number
H diacetylmorphine
AC acetylcodeine
6AM 6-acetylmorphine
N noscapine
P papaverine
Form base or salt
Col color, as defined in the *Methuen Handbook of Colour*, Eyre Methuen, London, 1978.
ND not detected, detection limit 0.3%

All figures represent the percentage composition with respect to the total weight of sample.

TABLE 5—*Results of analysis of illicit heroin of Iranian origin.*[a]

No	H	AC	6AM	N	P	Form	Col
473	62.3	5.3	0.9	16	6	base	5D4

[a]Abbreviations:

No heroin sample serial number
H diacetylmorphine
AC acetylcodeine
6AM 6-acetylmorphine
N noscapine
P papaverine
Form base or salt
Col color, as defined in the *Methuen Handbook of Colour*, Eyre Methuen, London, 1978.

All figures represent the percentage composition with respect to the total weight of sample.

heroin hydrochloride from Thailand are typical of the product known as "Chinese No. 4." Both the single sample from Singapore and that from Hong Kong contained narcotics present as the free bases with similar purities to the "No. 4" presentation. All high purity SE Asian illicit heorin products continue to have relatively high acetylcodeine levels (4 to 11%).

Indian heroin shows few changes since the previous study. Sample Reference 452 underwent significant hydrolysis between forensic science examination and analysis as part of this survey and the diacetylmorphine content decreased by an order of magnitude from 50 to 4.5% over ten months. There was also one sample of this nature in the previous survey and both have been excluded from mathematical analyses for Table 8. There has been a signifi-

TABLE 6—*Results of analysis of illicit heroin of Nigerian origin.*[a]

No	H	AC	6AM	N	P	Form	Col
474	60.2	4.3	1.7	t	t	HCl	5A2

[a]Abbreviations:

No	heroin sample serial number
H	diacetylmorphine
AC	acetylcodeine
6AM	6-acetylmorphine
N	noscapine
P	papaverine
Form	base or salt
Col	color, as defined in the *Methuen Handbook of Colour*, Eyre Methuen, London, 1978.
t	trace amount present

All figures represent the percentage composition with respect to the total weight of sample.

TABLE 7—*Most commonly encountered colors of illicit heroin products.*

Pakistan: all samples
1st survey (total = 95)
5C4 = 27, 5D4 = 14, 5B3 = 9, white = 9, 4A2 = 8, 5A2 = 7
2nd survey (total = 146)
5D4 = 67, 5C3 = 18, white = 10, 5B2 = 8, 5D5, 4A2 = 7 each
Pakistan: HCl samples
1st survey (total = 28)
white & 5B5 = 5 each, 5A2 = 4
2nd survey (total = 24)
White = 9, 4A2 & 5B2 = 4 each
Pakistan: base samples
1st survey (total = 67)
5C4 = 26, 5D4 = 12, 4A2 = 5
2nd survey (total = 122)
5D4 = 67, 5C3 = 18, 5D5 = 7
Iran
1st survey (total = 44)
5C5 = 8, 4B3 & 4C3 = 5 each
Turkey
1st survey (total = 42)
5C3 = 10, 4A2 = 7
India
1st survey (total = 15)
White = 6, 4A2 = 3
SE Asia
1st survey
"No 4" white = 12 (total = 13)
"No 3" 5B1 = 4 (total = 7)

TABLE 8—*Average narcotic contents of illicit heroin.*

Origin	Diacetylmorphine		Acetylcodeine		6-Acetylmorphine	
	1st Survey	2nd Survey	1st Survey	2nd Survey	1st Survey	2nd Survey
SE Asia	81.4	67.6	6.2	6.6	2.7	2.4
India	74.5	67.8	3.0	3.7	4.4	2.1
Pakistan						
All samples	65.1	69.1	4.7	5.0	8.4	1.9
Base	72.3	68.7	4.9	5.7	4.6	1.7
HCl	47.7	74.3	4.7	1.8	17.3	2.8
Turkey	50.5	58.9	3.7	4.7	2.2	1.8
Iran	72.0	62.3	5.4	5.3	1.8	0.9
Nigeria	87.4	60.2	2.2	4.3	4.9	1.7

cant reduction in the average 6-acetylmorphine content compared with the previous survey. Although both the average diacetylmorphine content is marginally lower and the acetylcodeine content is higher than previously, nevertheless Indian heroin is now a better made product.

Pakistani heroin constitutes 83% of seizures made over the duration of the present study. Heroin from this source is now available in two distinct forms, both of high diacetylmorphine content. The average diacetylmorphine content for the base is similar to the previous study, but is now much higher for the hydrochloride (Table 8). Only one sample (Reference 329) in the period of this survey failed to be accommodated by these two classes. This sample appears to have been badly made, in that a poor yield of diacetylmorphine was achieved during acetylation or the product has been insufficiently purified or both, so that hydrolysis to 6-acetylmorphine has occurred rapidly after acetylation. In the previous survey we identified 19 of these badly made products (representing 20% of the Pakistani samples). In both surveys the 6-acetylmorphine content of illicit heroin from Pakistan in the salt form is higher than that of the products in the base form, presumably indicative of the hydrolyzing effect of any excess acid in the sale presentation. The average 6-acetylmorphine content of Pakistani heroin in the present study is significantly lower than previously, particularly for the hydrochlorides. There is little deducible from the acetylcodeine averages for both surveys, although the acetylcodeine content is appreciably lower for the hydrochloride salt than for the free base form.

In the present survey, the chemical profile and physical appearances of heroin hydrochloride from Pakistan and India are indistinguishable.

The proportion of hydrochloride to base preparations from Pakistan has changed little over the period covered by both surveys. In the first survey, 28 out of 94 samples were in salt form but 16 of these were of poor quality. Thus the percentage of high quality hydrochloride salt presentations (13%) is similar to that for the second survey in which there were 24 out of 146 (16%) samples. For the first time in this laboratory, heroin tartrate has been encountered (Sample 350).

Illicit Pakistani heroin is now a consistent and well made product, with careful control of the acetylation stage, the stoichiometric addition of hydrochloric acid to produce the salt form, and the subsequent purification.

Procaine (two out of seven samples), caffeine (one out of seven), and calcium carbonate (one out of seven) were found in seizures of illicit heroin from Turkey. More significant is the reversal of the frequency of occurrence of salt and free base form in Turkish illicit heroin. In the previous survey, only 1 out of 42 samples was encountered as the base, but in the present survey 5 out of 7 samples contained narcotics as the base. The average diacetylmorphine content for Turkish illicit heroin is now only a little lower than that found in the other common high purity presentations (Table 8).

The single Iranian sample was seized in the early part of 1983 and was the first sample from this source since the beginning of 1980. It is representative of the high purity Southwest Asian product which contains narcotics as free bases.

The only Nigerian sample is similar to the one described previously. Given the unusual source, careful investigations were made to support the assignment of country of origin. The evidence supporting exportation from Nigeria for both seizures was overwhelming, although we recognize that it does not follow that the samples were manufactured in Nigeria.

There were no seizures of illicit heroin products from the Near East during the period of this survey.

Only Pakistan and Turkey have increased their average diacetylmorphine contents, while heroin from all the other common sources is now of a lower purity than hitherto.

Detailed examinations of packages of illicit heroin intercepted as part of larger importations were made on two occasions, both of heroin originating from Pakistan. On the first occasion the total consignment weighed 30 kg which has been divided before shipment into 30 packages of approximately equal weight. A representative sample from each package was analysed and the results are presented in Table 9. It was concluded on the basis of the comparable levels of constituents and of the relatively small values obtained for the standard devi-

TABLE 9—*Variation of the narcotic content in a single seizure of 30 kg of heroin consisting of 30 packages.*

	% Range	% Average	Standard Deviation
Diacetylmorphine	73.4 – 78.5	76.3	1.30
Acetylcodeine	5.9 – 7.0	6.4	0.20
6-Acetylmorphine	1.4 – 3.1	2.1	0.36
Noscapine	16.2 – 22.7	17.6	1.44
Papaverine	5.6 – 7.9	6.0	0.44

TABLE 10—*Variation of the narcotic content in a single seizure of 600 g of heroin consisting of twelve packages.*

	% Range	% Average	Standard Deviation
	ALL PACKAGES		
Diacetylmorphine	66.4 – 72.4	68.4	2.85
Acetylcodeine	3.3 – 7.4	5.2	1.80
6-Acetylmorphine	1.1 – 3.6	2.1	1.03
Noscapine	9.7 – 11.2	10.6	0.44
Papaverine	4.8 – 6.1	5.6	0.55
	GROUP 1 (FIVE SAMPLES)		
Diacetylmorphine	70.7 – 72.4	71.4	0.69
Acetylcodeine	6.6 – 7.4	7.1	0.33
6-Acetylmorphine	3.1 – 3.6	3.3	0.16
Noscapine	9.7 – 10.7	10.3	0.38
Papaverine	4.8 – 5.2	5.0	0.18
	GROUP 2 (SEVEN SAMPLES)		
Diacetylmorphine	64.4 – 68.7	66.4	1.55
Acetylcodeine	3.3 – 4.6	3.8	0.48
6-Acetylmorphine	1.1 – 1.5	1.3	0.13
Noscapine	10.5 – 11.2	11.0	0.45
Papaverine	5.9 – 6.1	6.0	0.09

ations, that the contents of all the packages were part of the same manufacturing batch of heroin. Inspection of all data from both surveys, representing over 400 different seizures, showed that no 2 heroin samples could be regarded as the same on the basis of similarity of chemical composition.

Examination of a second seizure, of total weight 600 g, consisting of twelve individual packages of heroin, gave much higher standard deviations of percentage composition, indicating that more than one manufacturing batch may be present (Table 10). Reexamination of the data showed that the packages fell into two groups, those with an average diacetylmorphine content of 72.0% and those with an average of 66.4%. Although this difference is not large, there were major differences in both the acetylcodeine and 6-acetylmorphine levels (Table 10). It was concluded that this consignment of heroin constituted material from two different batches.

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