THE MONOGRAPHS OF THE INORGANIC CHEMICALS OF THE UNITED STATES PHARMACOPOEIA—HOW MAY THEY BE IMPROVED?*

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The monographs of chemical substances in the U. S. P. IX constitute nearly one-half of the total number of monographs in the book and of these one hundred and sixty-eight were either in whole or part referred to Sub-Committee No. 5 on Inorganic Chemicals, of which I had the honor to be the chairman during the active part of the revision period.

To properly consider this subject it is necessary to view first a longitudinal section of the entire centennial period, taking a certain single substance, for example, and then view a transverse section of that same substance as afforded by a number of representative foreign pharmacopoeias.

Sodium Bicarbonate has been selected for this rather unusual study, and a survey of the collected facts will be found of great interest in drawing conclusions as to what improvements, if any, can be made.

1820—Sodium Bicarbonate was called simply carbonate of soda, Na_2CO_3, being then called subcarbonate. A process was given for preparing it by crystallization from a solution of sodium subcarbonate and ammonium carbonate, which was directed to be heated gently until the NH_3 had been driven off. No tests were given for identity or purity. Total number of words in the monograph, 80.

1830—Still called carbonate of soda, with the synonym *Sodae Bi-carbonas* given. It is directed to be made from the subcarbonate (Na_2CO_3) by dissolving it in water, passing into it CO_2 to saturation and then allowing the solution to crystallize. No tests for identity or purity are given, but the statement is made "less soluble than the carbonate." Total number of words in the monograph, 89.

1830—2nd Edition. It is here for the first time called only Bicarbonate of Soda, and is made as in the preceding process. Total number of words in the monograph, 101.

1840—Official as *Sodae Bicarbonas*. Directions are given for preparing it by taking broken crystals of sodium carbonate and placing them in a suitable vessel in which they may be exposed to the action of a stream of carbon dioxide until fully saturated. The following description and tests are given:

"The salt is white and opaque and wholly soluble in water. By a strong heat it is converted into anhydrous carbonate of soda. Its solution, unless heated, does not yield a precipitate with sulphate of magnesia."

Total number of words in the monograph, 192.

1850—Official again as *Sodae Bicarbonas*. Same method of preparation as in 1840. The tests have been slightly elaborated as the following will show:

"The salt is white and opaque and wholly soluble in water. By a strong heat it is converted into anhydrous carbonate of soda. Its solution slightly affects the color of turmeric and is decomposed by effervescence with acids. It does not yield a precipitate with chloride of platinum, nor, unless heated, with sulphate of magnesia. The precipitate produced by chloride of barium is wholly soluble in nitric acid."

Total number of words in the monograph, 204.

1860—Exactly the same as in 1850 as to title, and essentially the same as to method of preparation and tests. Total number of words in the monograph, 223.

1870—*Sodii Bicarbonas Venalis* (Commercial Bicarbonate of Sodium official in primary list). This was evidently a mixture of carbonate and bicarbonate, for among its properties the following statement is made: "When dissolved in successive portions of water, the first

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portions of the solution produce with solutions of corrosive sublimate a reddish brown precipitate; the latter portions have no effect."

From the latter was made:

Sodii Bicarbonatis: by washing it in a percolator with distilled water until the washings cease to precipitate a solution of sulphate of magnesium. It is then directed to be dried on bibulous paper in a warm place.

The description and tests are as follows:

"A white, opaque powder, wholly soluble in water. It does not precipitate a cold solution of sulphate of magnesium, nor is a solution of the salt in forty parts of water precipitated by corrosive sublimate. The precipitate produced by chloride of barium is wholly soluble in nitric acid."

[5]Total number of words in the two monographs, 204.

1880—*Sodii Bicarbonas and Sodii Bicarbonas Venalis* are both recognized but no process is given to produce the former by purification of the latter. The chemical formula and molecular weight were given alike under both titles and under the latter it was stated that it is "corresponding in physical properties and reactions of identity to *Sodii Bicarbonas,*" to which are added tests for limit of chloride (no immediate precipitate with test solution of nitrate of silver in a one percent solution of the salt) or of sulphate (a similar test with chloride of barium T. S.). A test for limit of carbonate was given by directing that a saturated cold solution should not yield more than a slight precipitate with a concentrated solution of sulphate of magnesium. A titrimetric test for purity with oxalic acid V. S. was given and a minimum of 95 percent purity was required.

Under *Sodii Bicarbonas* were given the following classified data:

Physical description.
Solubilities.
Effect of heating.
Identity tests.

Tests for impurities (the same limits of chlorides and sulphates were given as under the commercial salt).

Tests for absence of ammonia and carbonates were also given.

Assay—By titration with oxalic acid V. S. and a requirement of 99 percent purity; no indicator mentioned.

In conclusion a list of preparations into which the salt entered as an active ingredient was given. Total number of words in the monograph, 279.

1890—*Sodii Bicarbonas* only (the *Venalis* having been dropped).

The arrangement of the text is as follows:

Latin title.
English name.
Chemical formula and molecular weight.
Method of preservation.
Physical description and properties.
Solubilities.
Identity tests.
Tests for impurities including the following:
- Mechanical impurities.
- Sulphocyanates.
- Potassium.
- Carbonate.
- Arsenic and heavy metals.
- Calcium.
- Chloride.
- Sulphate, sulphite, hyposulphite.
- Ammonia.

Assay—By titration with normal sulphuric acid, 98.6 percent purity being required. Methyl orange directed as indicator.

A list of preparations is given in which it is the active ingredient. Total number of words in the monograph, 534.

1900—(8th Revision) *Sodii Bicarbonas.*

The arrangement of the monograph is as follows:

- Latin title.
- English name.
- Chemical formula and molecular weight.
- Rubric (Statement of purity requirement of 99 percent) and method of preservation.
- Physical description and properties.
- Solubilities.
- Effect of heat.
- Identity tests.
- Tests for impurities including:
  - Ammonia.
  - Mechanical impurities.
  - Carbonate.
  - Sulphocyanate.
  - Heavy metals.
- Assay—By titration with normal sulphuric acid using methyl orange as indicator.
- Average dose.

Total number of words in the monograph, 350.

U. S. P. IX—*Sodii Bicarbonas.*

The arrangement of the monograph is as follows:

- Latin title.
- English name.
- Abbreviation.
- Rubric (requiring 99 percent purity after drying).
- Directions for preservation.
- Physical description and properties.
- Solubilities.
- Effect of heat.
- Identity tests.
- Tests for impurities, including the following:
  - Ammonia.
  - Mechanical impurities.
  - Carbonate.
  - Heavy metals.
- Assay—By titration with normal sulphuric acid, using methyl orange as indicator.
- Statement of neutralizing value in terms of normal sulphuric acid and *vice versa.*
- List of official preparations in which it is an active ingredient.
- Average dose.

Total number of words in the monograph, 318.

A careful study of the foregoing will convince the observer that instead of having become longer and more complex, this text, which is typical of its class, has been simplified and shortened. The highest peak of verbosity and detail was reached in the 1890 Edition, which contained 534 words as compared with 318 words for the same monograph in the U. S. P. IX.

One marked change also will be seen in the phraseology that where it was formerly the practice to use the subjunctive mood and state that "if" such a procedure were followed a certain result would ensue, the declarative style is now used in its simplest form. Another change that will be noted is that while in some of the former editions the *key words* of the tests for impurities were accompanied by qualifying terms such as *absence of* and *limit of*, in the present edition they are unqualified.

A survey of the texts of the same chemical in a number of the important

foreign pharmacopoeias will be interesting for comparison. In the interests of space these data are tabulated as follows:

SODIUM BICARBONATE IN FOREIGN PHARMACOPOEIAS.

Name of pharmacopoeia	Belgian	Norwegian	Danish	Italian	Swedish	Nederland
	Latin					
Title of substance	*Natrium Bicarbonicum*	*Bicarbonas Natricus*	*Bicarbonas Natricus*	*Bicarbonato di Sodio*	*Bicarbonas Natrico*	*Bicarbonas Natricus*
Abbreviation	None	None	None	None	None	None
Rubric	None	None (symbol and mol. wt.)	None (symbol)	None	None	None (symbol)
Directions for preservation	None	None	None	None	None	None
Physical description and properties	Yes	Yes	Yes	Yes	Yes	Yes
Solubilities	Yes	Yes	Yes	Yes	Yes	Yes
Identity tests	Yes	Yes	Yes	Yes	Yes	Yes
Tests for impurities	Ammonia Heavy metals Chloride Sulphate Sulphocyanate Carbonate	Iron Heavy metals Chloride Sulphate Sulphocyanate Thiosulphate	Ammonia Heavy metals Chloride Sulphate Sulphocyanate Carbonate	Ammonia Arsenic Chloride Thiosulphate Carbonate	Heavy metals Chloride Sulphate	Ammonia Heavy metals Arsenic Chloride Sulphate Sulphocyanate Carbonate
Key word	None	Yes (unqualified)	None	Yes (unqualified)	None	None
Assay	By ignition after desiccation 63.8 per cent residue	None	Same as Belgian	Same as Belgian	Titration with HCl *N*/1	None
List of preparations	None	None	None	Yes	None	None
Dose	None	None	None	None	None	None
Number of words in monograph	179	164	137	185	131	186

SODIUM BICARBONATE IN FOREIGN PHARMACOPOEIAS.

Japanese (English)	Austrian (Latin)	British (English)	French Codex	German	Spanish	Swiss (German)
			French			
Natrium Bicarbonicum	*Natrium Hydrocarbonicum*	*Soddi Bicarbonas*	*Natrium Bicarbonicum*	*Natrium Bicarbonicum*	*Bicarbonico Sodico*	*Natrium Bicarbonicum*
None	None	None	None	None	None	None
None (symbol) and mol. wt.)	None	Yes 98.5 per cent	Yes (Chem. Form. and mol. wt.)	Yes (Chem. Form. and mol. wt.)	None (Chem. Form. and mol. wt.)	None
None	None	Yes	Yes	None	None	None
Yes	Yes	Yes	Yes	Yes	Yes	Yes
Yes	Yes	Yes	Yes	No	Yes	Yes
Yes	Yes	Yes	Yes	No	Yes	Yes
Ammonia	Ammonia	Ammonia	Ammonia	Ammonia	Ammonia	Ammonia
Chloride	Heavy metals	Heavy metals	Heavy metals	Heavy metals	Heavy metals	Heavy metals
Sulphate	Chloride	Chloride	Chloride	Chloride	Chloride	Chloride
Sulphocyanate	Sulphate	Sulphate	Sulphate	Sulphate	Sulphate	Sulphate
Carbonate	Sulphocyanate	Sulphite Thiosulphate Lead (special) Arsenic Carbonate Thiocyanate	Carbonate Insoluble matter Organic matter	Carbonate Potassium	Carbonate Potassium	Sulphocyanate
None	None	Yes	Yes (unqualified)	Yes (unqualified)	None	None
Same as Belgian	Same as Belgian. Also by titration with normal acid	By titration with normal sulphuric acid	Same as Belgian	Same as Belgian	Same as Belgian	Same as Belgian followed by titration with normal sulphuric acid

None	None	None	None	None	None	None
None	None	Yes	None	None	Yes (thera-	None
		Saturation equivalents of organic acids given	Medical uses and incompatibilities given		peutic action)	
130	171	224	452	219	119	100

It will be seen from a comparison of the data submitted that in comprehensiveness and detail the U. S. P. IX stands at the head of all of the pharmacopoeias of the world. This is, of course, accompanied by an increased use of space, only one national pharmacopoeia, the French Codex, exceeding us in this respect; but the French Codex while being more verbose is not nearly so comprehensive nor exact.

In no other pharmacopoeia is such careful attention paid to the minute details of phraseology which go to make up exactness in directions, and yet our work is by no means free from flaws or criticisms in this connection.

The present U. S. P. Sub-committee on Inorganic Chemicals, under the leadership of Chairman H. V. Arny, is attempting to solve one vexing problem in advance of the next revision. This is in connection with the tests for chlorides and sulphates which are difficult to describe in such a manner as to leave no room for misunderstanding. Other pharmacopoeias have failed in this respect, for such phrases as "not more than opalescent," "no turbidity within two minutes," "faintly opalescent," "weak opalescence," "should remain clear for five minutes," "not more than the slightest reactions for," "no precipitate," are found in connection with these tests in the foreign monographs just reviewed. Without accurate definitions of opalescence, etc., there is always room for argument, and argument upon such minor points as this (even when an article conforms to the purity established in the rubric) seems to be the favorite indoor sport of many of our American chemists and purchasing agents.

If the United States Pharmacopoeia is to remain a book of widely and frequently used standards as well as a guide for physicians and pharmacists, and if no change is made in the policy of revision, it is difficult to see how the texts of this group of substances can be much abridged, although improvement is undoubtedly possible along lines of simplification and in uniformity and exactness of phraseology. In fact what is needed very much in the next revision is an editorial committee who shall share the burden of responsibility which has been placed entirely upon the chairman of the General Committee of Revision in times past.

Abridgment can come only through the increase of general tests. Whether these are possible for many substances in such a large group of diverse substances remains to be seen. By the introduction of general tests for chlorides, sulphates, etc., and even for identity tests, as is done in the British Pharmacopoeia, the size of the monographs on inorganic chemicals in the next edition of the United States Pharmacopoeia can be reduced by at least twenty-five percent, which will be a great gain in space and will carry with it certain marked advantages to the users of the book who are not seeking chemical details, but are consulting it from the standpoint solely of the prescriber or the dispenser.