

CHAPTER XV

Distillation

Knowledge that vapors rising from bodies of water were purer than their origin was recorded by many ancient writers. Rain water, regarded as condensed vapors, was by some given first place among natural sources of supply. Aristotle (384–322 B.C.) notes that pure water can be obtained by evaporating sea water (1). St. Basil (c. 330–370 A.D.) in his fourth Homily on Genesis (2) says, "Sailors, too, boil even sea-water, collecting the vapor in sponges, to quench their thirst in pressing need."

The first known treatise on distillation is attributed to Geber or Jabir, an Arabian chemist who was born in 721 or 722 A.D. (3). Geber defined distillation as "an elevation of aqueous *Vapours* in their *Vessel*," some by and some without fire. The special object of distillation "which is made by ascent into the Alembick, is the desire of acquiring Water Pure without *Earth* . . . for the *Imbition* of *Spirits*, and clean Medicines. When We need Imbition, We must have pure Water, which leaves no *Feces* after its *Resolution*; by which *Feculency*, Our Medicines and cleansed *Spirits* might be infected and corrupted."

"Johannes Gadeeschen, sive Johannes Anglicus, anno 1516," according to Stephen Hales (4), "says that Sea-Water may be sweetened four ways, *viz* by filtrating through Sand; By Clean Linen laid over a Boiler, and squeezing the Moisture out, as from Sponges; By Distillation: As also by their Bowls made of white Virgin Wax, which 'tis said will free the Water from its Saltness, and from some part of its nauseous Bitter."

In 1595, *A newe booke of Destyllation of Waters, called the treasure of Evonymous*, by Conrad Gesner, appeared (5). Among other woodcuts it contains one showing a still inserted in a vessel beneath which sticks of wood are burning. Sir Richard Hawkins, in a sea voyage begun in 1593, distilled sea water to obtain fresh water (6). In his *Sylva Sylvarum*, published posthumously in 1627, Sir Francis Bacon (7) stated that "the Taste of Water, in Distillations by Fire, riseth not." His explanation was untenable. He also noted that "Distilled Waters of Wormwood, and the like, are not Bitter" (Expt.

881) (7). Two books on distillation were published in 1651: one by Glauber (8); the other by French (9).

Interest in distillation had reached such a point by the close of the seventeenth century that it gave rise to commercial exploitation of distilling apparatus under the protection of patents. Forerunner of numerous patents on distillation and notable as the first-known patent on water purification of any type was one granted October 28,

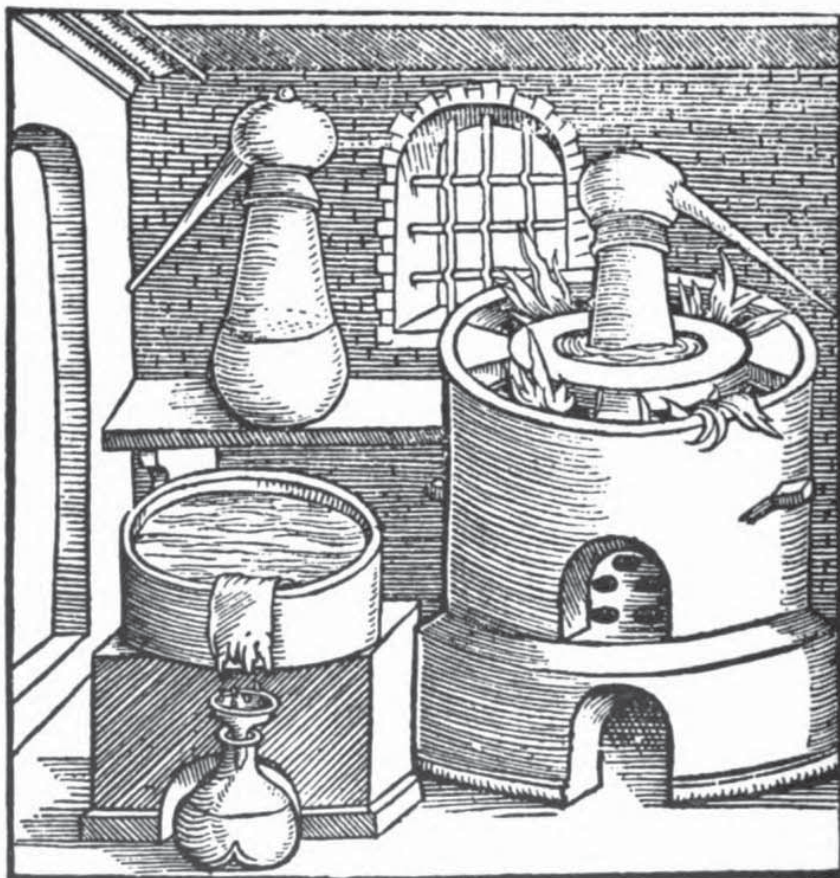


FIG. 66. STILL AND WICK SIPHON

Ancient distillation equipment, *circa* 8th Century A.D.

(From *The Works of Geber*, London, 1928)

1675, to William Walcott on the "art of making corrupted water fit for use, and sea water fresh, clean and wholesome in very large quantities, by such wayes and means as are very cheap and easy, and which may be done and practiced with great speed." This was soon followed by a patent, also British, issued to Robert Fitzgerald and four associates for an "Engine for rendering salt water sweet and fit

for cooking, washing and other purposes" (January 9, 1683). These grants were made the personal concern of King Charles II. Whether he was fully informed as to the nature of the methods proposed, and particularly the "ingredients" to be used is not made clear. To others, they were veiled in mysterious secrecy which, a half century later, appeared to Dr. Stephen Hales to be humbuggery. This, together with much information on the patents, the ensuing rivalry between the patentees and the attempt of the Fitzgerald group to exploit their apparatus, was told by Dr. Hales later in the preface to his *Account of Some Attempts to Make Distilled Sea-Water Wholesome* (4). Hales describes two allegedly successful installations of Walcott's stills on shipboard, one of which was in 1683, and urges that the space required to store coal for the stills was much less than that required to store casks of fresh water. He suggests the use of tinned instead of plain copper for stills to obviate "an ill Quality of Vomiting" given to the water by plain copper. Hales noted that "after several Tryals at Law between the Patentees, Mr. Walcott's Patent was superseded and laid aside; against which Mr. Walcott brought a Bill in Parliament in the year 1694, which passed the Commons, but not the House of Lords." Thus did litigation over water treatment patents begin as early as two and a half centuries ago.

The rise of Fitzgerald to fame, his government orders and the sad end of his partnership and apparatus are thus narrated by Hales:

Mr. Fitz-gerald's method met with such great applause that a Poem was published to celebrate his Praise, and silver Medals were made, representing and illustrating the Art of this new Inventor. A Still of his was set up at Hull and Sheerness: and by Order of the Council in the Year 1692, two of them were to be set up in the Islands of Jersey and Guernsey; but with no good Effect: The distilled Water was fiery, harsh and corroding. And in a little Time the Persons concerned with Mr. Fitz-gerald, finding themselves extreamly disappointed in their expectation, withdrew from any Partnership with him: Insomuch that his Instruments, which were dear enough before their Effect was known, were soon sold for old Goods, for want of a vent for them at Sea. (4)

Hale's own method of "procuring wholesome Water from the Sea," based on experiments and observations of the ideas expressed by others, was "first to let it putrify well, and then become sweet before it is distilled."

Interesting both as a human document and as a scientific paper is Robert Boyle's account of his investigation of the Fitzgerald process

for distilling sea water (10). Charles II had doubts about the efficiency of the apparatus and the quality of the distillate. He called on Boyle for advice. The scientist passed on to the inventors all questions regarding the "engine" or distilling apparatus. He convinced the king and a group of nobles that the distillate was free from salt. Later, with the permission of the king, he disclosed that his tests for saltiness were made with silver dissolved in *aqua fortis* and noted that it did not produce a cloud or precipitate. A spirit of nitre test was also used.

Pamphleteering on behalf of the Fitzgerald stills was continued in 1684 by Dr. Nehemiah Grew with a statement of the approbation of the College of Physicians (11).

Not until nearly a century after the Walcott and Fitzgerald patents were additional patents for water purification granted in England. There were two issued, both relative to distillation. One was taken out by Bartholomew Dominiceti, December 6, 1770, and covered "many particulars," including apparatus for disinfection. The other was granted to Alexander Mabyn Bailey on July 19, 1777, for "A Machine for making fresh water from sea water or brine springs without boiling"—heat was used, so presumably this was distilling apparatus. Up to at least 1805, no further patents for distillation were granted in England (12).

During the nineteenth century, particularly during the last half, distilling apparatus was developed to a high degree of perfection, in the character of the distillate, compactness of apparatus and unit cost of installation and operation. Its use continued to be limited primarily to ships and naval bases. Coincident with the opening of the Suez Canal, the British government installed sea-water distillation plants on or near the canal (13). Of these, one at Aden seems to have afforded the main supply of potable water at least until 1927, when a deep well was completed (14). So far as found, distillation has never been applied to municipal supplies of fresh water except at three lumbering camps in Texas—Diball, Manning and Wiergate. At these camps the supply is drawn from ponds in which logs are retained for some time. Water for cooking and drinking was distilled at least as early as 1932 and the practice was in use in 1939, according to V. M. Ehlers, Director of the Bureau of Sanitary Engineering of the Texas Board of Health (15).

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15. EHLERS, V. M. Personal Letter. Austin, Texas (September 6, 1939).

CHAPTER XVI

Aeration in Theory and Practice

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2. COLUMELLA, LUCIUS JUNIUS MODERATUS. *Of Husbandry*. A. Millar, London (1745). [J]
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