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DRYING BY THE DIRECT APPLICATION OF HEAT-DISTILLATION.

The drying of substances by the direct action of heat, the separation of solid substances from the water they contain, and the separation of fluids by virtue of the different temperatures at which they are converted into vapor, comprise some of the most important operations in the industrial arts. The manufacture of alcohol, turpentine, the separation of petroleum oils, and many chemical processes depend more or less upon the principle of distillation.

Solid substances that are uninjured by the action of heat may have their moisture expelled by heating them directly, or without the intervention of conveyers of heat like air or steam. The heat required in this process is, in surface drying and exclusive of waste, just that required to convert the adhering fluid into vapor. In distillation, unless the apparatus be properly constructed, a very large portion of the heat employed will be wasted. This may be illustrated by the attempt to distil off water from a long necked glass flask, the heat being applied at the bottom. The water will be converted into steam and, rising, will condense in the neck of the flask and trickle down the sides, only a small percentage of the steam passing out from the mouth of the flask.

Now if in trickling down the sides, the fluid should arrive at a ledge or trough, so to speak, which would arrest its flow downward and conduct it to a pipe or tube leading out of the flask, the water would be conveyed away, and would not require the repeated addition of heat to expel it. This redistillation is, however, useful in some processes, and so some stills are constructed with a view to encourage the action described rather than retard it.

The process of distillation may be applied to remove useless fluids from substances which are valuable, or to extract from a worthless substance a valuable fluid, as brandy from fermented grape pomace, etc. It is often employed to separate substances from each other, none of which are worthless. This is the case in the manufacture of petroleum oils.

Crude petroleum is a mixture of a great number of fluids of widely different specific gravities and boiling points. If the mixture be exposed, in a still, to the constant temperature at which the most volatile of its constituents distils over, this lightest hydrocarbon will be separated from the others. Then if the heat be raised and maintained steadily at another temperature, another hydrocarbon distils over, and so on, the successive operations constituting what is called fractional distillation.

The proof of alcohol is raised by repeated distillation, the alcohol boiling at 180° and water at 212°; a portion of the latter distils over with the alcohol, a less percentage remaining at the end of each distillation: till a certain limit is reached, at which the attraction of the alcohol for the remainder of the water is so great that heat will not separate them.

Both chemical and mechanical action may be employed in connection with the direct action of heat for the drying of single, or the separation of mixed, substances, but as we propose to discuss these methods in future articles, we will not touch upon them further at present.

It is as proper to speak of drying a liquid or a gas as a solid. The chemist sees no distinction between these operations, except that of detail. Yet it is obvious that when a liquid does not unite or mingle with water, it can be wet only on one surface. It will float like oil, in which case only its lower surface is moistened, or sink like mercury, the water stratum rising to the surface. In such cases the application of heat is not the best way to perform the separation, decantation being much quicker and more economical.

There is also a very wide difference in the attraction of substances for water. Thus solutions of potash, which yield a portion of their water under the action of heat, finally reach a point of concentration beyond which no further loss of water will take place, no matter how high the heat may be carried. In such cases, the remaining water generally chemically combines with the substances under consideration, forming what chemists style hydrates. Sulphuric acid is another example of this class of substances. It can be concentrated to a given point by heat, but beyond this no further evaporation of the water takes place without a proportional evaporation of the acid.

There are also certain substances which, having the same or very nearly the same boiling points, cannot be separated by distillation.

The construction of stills for different purposes greatly varies, and we cannot well discuss it in this place. Those interested in pursuing the subject can find information in Morfitt's Chemical Manipulations, Ure's Dictionary of Arts and Manufactures, Dussauce's Treatise on the Manufacture of Vinegar, and Duplais on Alcoholic Liquors, in one or other of which works the processes of distillation, as conducted in different industries, may be found.

THE RELATION OF SCIENCE TO RELIGION.

In America, where the law of primogeniture does not exist, and the office of President is open to the aspiration of any adult citizen who may be politically shrewd or militarily lucky enough to obtain it, we do not esteem birth and ancestry as much as do people who reside in Europe. We judge men more on what they are than upon what their ancestors were. We would not care much if it should be proved that, some million of ages ago, our ancestors were apes, as Professor Rudolf Virchow* and others would have us believe. Those distant relatives are no doubt entitled to our respect, but it is not to be supposed that the account of them, given to us by Darwin, Wallace, and others of that school, should inspire us with rapturous affection. Neither are we thereby induced to own the members of the simian race, who occupy sumptuous apartments in Central Park, as men and brethren. To have sprung from this apparently ancient line does not seem to humiliate Professor Virchow. On the contrary, he prides himself on it.

"Morally speaking," he says, "it assuredly affords a higher satisfaction to think that man has raised himself, out of that state of rudeness, ignorance, and bondage, to one of morality, knowledge, and freedom, than to imagine that by his own fault he has fallen from a condition of Godlike perfection into one of meanness, pollution, and sin, to redeem him out of which his own strength is insufficient."

This passage, which occurs near the close of Professor Virchow's essay, gives a clear insight into the theological attitude of the author's mind, which is far from orthodox. In this age, however, heterodoxy is not as horrifying as it was once, when to doubt a religious dogma was to be doomed to social ostracism, if not to active persecution. Besides, at present many eminent scientific men are advocating similar views to those of Professor Virchow, and share his heterodox opinions. It is quite impossible, therefore, to disregard, if we were so inclined, this modern scientific skepticism, which meets us almost everywhere in scientific discussions.

Müller teaches us that the mythology or religion of the ancients was an attempt to express ideas and conceptions of things which were to them mysterious and inexplicable in the state of knowledge which then prevailed. Geologists affirm that the Mosaic account of the creation of the world must be either taken in an allegorical sense, or rejected. Huxley holds views decidedly antagonistic to what is generally called revealed religion. Darwin and his school endeavor to explain existence by the development theory, and so on to the end of the chapter. We repeat that it is impossible to avoid meeting this phase of scientific discussion, and as the essay of Professor Virchow affords an excellent sample of the reasoning which gives such skepticism birth, we propose to base upon it some general remarks.

All scientists have agreed that what can neither be demonstrated as a fact, nor logically inferred from facts, has no place in science. Reasoning by analogy can therefore have a comparatively limited sphere in science. For although well determined analogies are facts, the chances are ten to one that a supposed analogy will, when critically examined, turn out to be only a *pseudo* resemblance.

What we charge against the teachers of this school is that, while their development theory is purely a system of analogical reasoning, they do not declare that this or that conclusion is *probably* correct, but assert it as fact, and as dogmatically as the most ultra and fanatical religionists, whose bigotry they denounce. Thus Huxley, in his address on protoplasm, asserts as positively that in this substance we have the ultimate physical basis of life, and that protoplasm has its origin in the chemical combination of carbon, hydrogen, oxygen, and nitrogen in the presence of living protoplasm. The whole tone of his address, though he did not say as much in words, was a sort of triumphant self congratulation that there was no need of supposing a special creator, since chemical affinity was the general cause of animated existence. Is then chemical affinity the cause uncaused? Have we yet, or shall we ever arrive at the cause uncaused? Does the development theory, the knowledge of protoplasm, help us in recognizing the first of all causes? Would even spontaneous generation, if proved to take place, as many have sought to prove, reveal a cause behind which we can affirm no other cause can stand? From the very nature of the case, we can answer these questions in the negative.

So long, then, as mysteries exist, and this will always be the case, man will by faith stretch out his hands toward the hidden realm, and hope that in that realm there may be something, to satisfy the aspirations of his soul, brighter and better than what he has found through all his gropings. And this faith will form the basis of some kind of religion. The majority of men may perhaps be taught to believe that the human race sprang from apes, but so believing, and seeing the enormous distance they have progressed from the condition of those animals, they will hardly set limits to progress, and will be little convinced that all opportunity for individual advance is limited to the few toilsome years which form the average term of human life.

The skepticism of the present day is based upon as blind a faith as the belief of the orthodox. But we do not care to quarrel with this faith, or with conclusions derived from pure speculation, any more than we would quarrel with faith in revealed religion. The question of religious belief is one which has no place in scientific discussion. All scientists admit this, yet there are many who omit no opportunity to give sly and sarcastic thrusts at the belief held by many wise and good men, which, forming the very character of the men who entertain it, is deserving of respect rather than ridicule, not to speak of its intrinsic claims to the acceptance of intelligent minds. Professor Huxley has been particularly obnoxious in this way, and has thereby greatly limited his influence as a public teacher.

It may be replied that as the religionists attack the scientists, the latter must make some reply in self defence. We do not see the necessity. It is the business of science to discover, record, and classify facts. Whether these facts conflict with or confirm the religious faith of any, does not concern in the least the scientific investigator. If he discovers that the ancestors of mankind were apes, it is his duty to announce his real or supposed discovery; it is not his province to turn upon those who have held a different view and hold them up to scorn or ridicule because they believe they sprang from a higher source, and repudiate their anthropoid ape ancestors. If religion be false, it needs no direct attacks to kill it. If the discoveries of science be facts, they will outlive all false notions and superstitions. Science and religion should not be directly antagonized, for, besides that this is needless, neither one nor the other is benefited by such controversies.

All this we can say, while we own to a decided leaning toward the evolution theory. It seems more consistent with the way in which an All-wise Being would work, that through eternal and immutable laws He should evolve the varied complex structures which people the universe, than that each should be the result of a special act of creation. In this we see nothing that conflicts with such an interpretation of the Mosaic account as would harmonize with the now very generally conceded allegorical and poetical character of that portion of the Bible.

*Half-Hour Recreations in Popular Science, No. 2. The Cranial Affinities of Man and the Ape. By Professor Rudolf Virchow. Author of Cellular Pathology, etc. Boston: Lee & Shepard. New York: Lee, Shepard & Billingham.

PISTON ROD PACKING.

It is probable that, on the whole, with engines of plain construction, no part is more frequently out of order and gives more annoyance than the packing of the piston rod. The hemp gasket, when properly made, serves a good purpose, but its usefulness is limited. The gland requires frequent tightening; and, after a time, a peculiar change in the character of the material takes place, where high pressure steam is used, resulting in loss of elasticity and final worthlessness.

A vast deal of study and ingenuity have been applied to the removal of this annoyance, and the production of an unobjectionable piston rod packing. Wire packing has been patented. Copper wire gauze has been employed to pretty good purpose, though with not wholly satisfactory results. Combinations of various materials such as cotton, rubber, etc. have been tried without much success. There is still a general want of a permanent and reliable piston rod packing. The latest substance successfully employed in this country for this purpose is, we believe, asbestos, sometimes called mineral flax. Asbestos consists of silicates of magnesia and lime, generally with protoxide of iron and manganese. This substance is pliable when massed together, and is absorbent of oil, unchangeable under the action of even very high temperatures, can be wrought into gaskets like flax or hemp, and seems well adapted to supply the want named. It exists in large quantities, and can be cheaply put in market, in quantity and quality suited to the purpose.

Mr. St. John Vincent Day, C. E., recently read a very instructive and suggestive paper* on packing piston rods with asbestos, before the Institution of Engineers and Shipbuilders in Scotland, in which he states that asbestos has now been employed in that country with results justifying its further trial. He exhibited examples of asbestos packing, one of which had been used three months on an American locomotive with steam at 130 lbs., the locomotive making an average run of 150 miles per day, the packing being apparently as flexible and tenacious as when first employed.

Another example was shown, taken from the locomotive employed to draw the fastest train on the Caledonian line; and it was stated that the best ordinary packing lasted, with constant screwing up, only two months at most, rarely so long. The packing shown had been in use three weeks, during which the engine had run 2,000 miles, while the gland screws had never been once touched. The packing was as good as when put in.

An asbestos packing put into the stuffing box of a passenger

*See page 113 of the current volume of the SCIENTIFIC AMERICAN.