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POLLUTION OF POTOMAC RIVER.

**POLLUTION OF THE POTOMAC RIVER AND ITS RELATION TO THE
WATER SUPPLY OF THE DISTRICT OF COLUMBIA, BY MAR-
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MARCH 1, 1905.—Presented by Mr. GALLINGER and ordered to be printed.

The following observations with reference to the quality of water in the basin of Potomac River and the damage to its resources arising from indiscriminate pollution maintained at numerous points have been made during an investigation of the water resources of said basin, which is a part of the work carried on by the United States Geological Survey under the authority of an act of Congress approved April 28, 1904 (33 Stat., 486).

The determination of water supplies and the best methods of utilizing water resources involves a consideration of pollution, and as the facts collected in this instance are of particular importance to the District of Columbia, they are here compiled and forwarded in advance for the information of the Commissioners of said District.

While the Potomac drainage area is inhabited the water in the river will inevitably be polluted, the damage caused increasing as the population increases. This is a general law which applies to all river systems. The number of people living upon a drainage area and their relation to a stream is always reflected with a fair degree of accuracy in the quality of the water. Even if every approved appliance for the purification of waste were installed in connection with all the municipalities and manufacturing plants on the Potomac basin the water in the river would not be constantly fit for domestic consumption in its raw state. The pollution arising from the natural drainage of occupied land and the incidental contaminations which must occasionally occur in an inhabited area offer possibilities too serious to disregard. It would be necessary to practically depopulate the Potomac drainage area to secure an unpolluted river water at Great Falls. A proposition looking to this end would be absurd and fanatical. Therefore in taking up the consideration of Potomac pollution it will be necessary to start with the assumption that the river must be polluted.

The assumption just recited is by no means an admission that the Potomac may be converted into a stream of liquid filth. The pollution arising from the natural drainage of occupied land is a reasonable one. No stream ever becomes a public nuisance by reason of it, nor does it cause the defacement of landscapes by imparting ugly color or putrid appearance to a river. Fish are not killed nor driven away nor is the

water ever changed by it to a degree that renders it damaging to the industrial plant. In fact, there is hardly any line of water utility which need be materially affected by such pollution except that of domestic water supply. That the Potomac River must be polluted to a certain extent means simply that a certain price must be paid for the benefits derived from the political and industrial development of the upper Potomac basin. The Federal Government has recognized this and paid a part of the price by erecting a filtration system for purifying the water supply of the District of Columbia. Such expenditure was based upon an economic necessity; such necessity, however, extends only to that pollution which is unpreventable.

Potomac River is grossly abused. There seems to be throughout the entire drainage area a lack of regard for the purity of the water. Foul and putrid matter is deposited in the main stream and its tributaries at numerous points, apparently without reserve, and so far as the observer can determine there is little or no responsibility felt by the inhabitants of the drainage area concerning the effects which this material may have upon the interests below them on the streams. It is not necessary to resort to chemical or biological examination to prove that the Potomac is polluted; the facts are readily apparent to the observer.

In the following paragraphs the facts with reference to the pollution of Potomac River are reviewed in the order observed upon ascending the stream from Great Falls.

About 16 miles above Great Falls, Goose Creek enters the Potomac from the south. Leesburg, Va., a town of about 1,500 inhabitants, is situated on Tuscarora Creek, a tributary of Goose Creek, 8 miles above the confluence with the Potomac. No sewerage system has been established at Leesburg, yet the local pollution of the creek is considerable. Typhoid fever in this place, according to reports, has been common, and the distance from there to the District water intake at Great Falls is so short that a transference of the disease from one or two cases in Leesburg to several hundred in Washington would be a natural and expected occurrence.

The next important source of Potomac pollution is at Frederick, Md., on the Monocacy River, about 50 miles above Great Falls. Frederick is a city with a population of 9,296, according to the Twelfth Census, it having increased from 8,193 in the decade previous to 1900. The streets of Frederick are provided with surface drains which, in the course of time, have been made to conduct domestic wastes into Carroll Creek, a small tributary of the Monocacy flowing through the city. In addition to this there are several industrial plants which contribute wastes to the river, the most serious of which are tannery wastes and spent dye liquors.

At Frederick Junction, on the Monocacy, the toilets installed in the railroad station are drained directly into the river. This is probably the most serious source of pollution on the stream. Railroad station toilets, used largely by travelers, are more frequent sources of dangerous pollution than they are usually believed to be.

On the whole, the water contributed to the Potomac system by the Monocacy is of highly undesirable character, although it is not so grossly polluted as several of the other Potomac tributaries. The very fact that it enters the Potomac so close to the Washington intake renders the small amount of pollution which it receives of far more

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importance to the District of Columbia than a greater proportion of contaminating matter farther up the drainage area.

At Washington Junction, about 35 miles above Great Falls, there is a considerable source of pollution, both from the settlement and from the railroad station, the latter being similar to that described at Frederick Junction. This indeed is a more serious matter so far as Washington is concerned than that at Frederick Junction, for it is considerably nearer the Great Falls intake.

Weverton and Knoxville, situated about 45 miles above the Great Falls intake, are two slovenly settlements which hug the shore of Potomac River and contribute to the stream large quantities of dangerous pollution. It enters the river either by way of the Chesapeake and Ohio Canal or follows down the small brooks which drain the immediate area and run beneath the canal. Knoxville and Weverton are typical sources of disease, and it is from such that water supplies have been infected and disastrous epidemics resulted.

At Harpers Ferry, about 50 miles above the Great Falls intake, where the Potomac breaks through the Blue Ridge Mountains, the Shenandoah joins the main stream. This river drains a large area to the southwest, while the Potomac comes from the northwest. Harpers Ferry is a small, unprogressive village lying on the point opposite the junction of these two streams. Considerable organic matter enters the stream from this village, but the most noticeable sources of pollution are the two pulp mills, one of which is located on the Shenandoah, while the other is on the Potomac below the confluence of the two streams.

The wastes from these mills consist entirely of shavings, finely ground wood, and bark, and while they render the stream unsightly they undoubtedly have little effect upon the river so far as its healthfulness for domestic purposes is concerned. The effect upon fish is quite another question, which will be dealt with in a later communication. A brewery is located at Harpers Ferry and turns into Shenandoah River the wastes which usually arise in such an establishment. It probably has little or no effect on the water of the river. On the whole, while Harpers Ferry and vicinity appears to be a somewhat important center of pollution, there is in reality only a small amount of matter turned into the stream. In fact, the greatest sources of pollution at Harpers Ferry are the toilets at the railroad station.

Shenandoah River is fairly clean. It drains an area generally given over to farming, and the few villages of comparative importance along its course do not pollute the river to an extent generally observed in other parts of the drainage area. A little above Harpers Ferry, Flowing Spring Run empties into the river. This run carries the waste of the box-board factory and domestic sewage from Halltown. Still further up the stream Evitt Run joins the Shenandoah, carrying some pollution from the village of Charlestown. At Berryville the Shenandoah is polluted with domestic sewage. At Riverton the Shenandoah forks, the North Branch draining the broad valley between North and Massanutten mountains, while the South Branch drains the valley between the Massanutten and Blue Ridge.

In the valley of the North Branch of the Shenandoah there are no important industrial wastes, and the small towns like Mount Jackson, Edinburg, Woodstock, and Strasburg do not deliver a notable amount of pollution.

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On the South Branch Front Royal pollutes the river by way of Happy Creek, while Hawksbill Creek, another tributary which flows through Luray, is quite severely polluted by waste from an acetylene gas plant and the Luray tannery, as well as considerable sewage from the town. At Elkton the South Branch is polluted by another tannery, while a third located at McGeheysville and a fourth at Keezleton contribute the usual amount and character of waste.

At Port Republic the South Branch of the Shenandoah divides into North and South rivers. Into North River flows Blacks Run, which is badly polluted by the sewage of Harrisonburg and a large tannery. Harrisonburg is a village of 3,521 inhabitants, according to the returns of the Twelfth Census, having shown a growth of about 800 during the decade ending 1900. The town has been provided with a sewerage system which is discharged directly into Blacks Run, a quarter of a mile south of the town. Blacks Run is very foul and unsightly. In dry seasons the stream is practically dry, and very little except sewage and foul tannery wastes is seen in the channel. Altogether Harrisonburg presents the most serious conditions found along the Shenandoah.

Continuing up the Potomac from Harpers Ferry for about 9 miles, one encounters the mouth of Antietam Creek. The most important places on this stream are Hagerstown and Sharpsburg. The former contained, according to the Twelfth Census, 13,951 inhabitants, having increased a little more than one-third during the previous decade. Large quantities of filth are discharged from Hagerstown into Antietam Creek. The town is supplied with a surface-drainage system which, however, conducts a large amount of domestic sewage. In addition to the general discharge of sewage there is a large amount of industrial waste, some of which is of an extremely poisonous character.

There are 17 industrial plants in the city, from the greater part of which are derived industrial wastes. Among the most important of these are the dye works from which many thousand gallons of spent dye liquors and foul rinse waters are turned each day to the creek. There is also a paper mill at Hagerstown employing 60 hands. The stock is manufactured from wood pulp, old rags, and paper, and the dirty washings and lime bleach are discharged into a pit, the effluent from which finds its way directly into the stream. Altogether the conditions at Hagerstown are worthy of serious consideration.

Sharpsburg, lower down on Antietam Creek, appears to be an unkempt, primitive, lifeless place, from which a serious amount of pollution is discharged into the small run which drains the immediate area and leads directly to Antietam Creek. Considerable typhoid fever has occurred at Sharpsburg within the past year. Privy vaults are located directly over the creek, and the conditions favorable to the dissemination of the disease to persons using the water below are ideal.

A few miles farther up the Potomac is Shepherdstown, containing about 1,500 inhabitants. The creek which flows through the town and empties into the stream is lined with privy vaults and hog pens, the conditions being much the same as those described for Sharpsburg.

Martinsburg and Winchester are situated in the drainage area of Opequon Creek, which enters the Potomac a few miles above Shepherdstown. The wastes contributed by Martinsburg are distillery slops, spent dye liquors, wool scourings, and ammoniacal gas liquors;

while from Winchester are discharged all of those mentioned except the first, and in addition the wastes from a box-board factory and tannery. Both towns have water supplies but no sewerage. Nevertheless Opequon Creek is highly polluted with domestic wastes as well as industrial. The condition of this creek, therefore, when it enters the Potomac, is extremely unsatisfactory.

The next important source of pollution along the Potomac is Paw-paw, which at the present time discharges large quantities of foul tannery liquor into the stream. This, however, is not a permanent pollution, as the industry is to be discontinued in the course of the present year.

South Branch of Potomac River is in better condition than any other tributary area in the drainage system. It is a beautiful stream, flowing between high hills and polluted only at Moorfield and Petersburg, where a considerable amount of tannery waste is discharged into it.

North Branch of Potomac River is the most important from the standpoint of pollution. Within its drainage area are situated the city of Cumberland and various other important towns, together with a large part of the West Virginia coal fields. The water is highly polluted with sewage, industrial wastes, and mine refuse, and altogether the case presented is one which it will be difficult to regulate.

Cumberland, Md., is an important center, containing at the last census 17,128, and showing a growth during the decade previous of nearly 50 per cent. The city is situated at the junction of North Branch and Wills Creek, and seems to be the focus for all the polluted water in the region thereabout. Within the city there are numerous industrial plants, such as tanneries, breweries, etc., together with a system of sewerage which discharges directly into the stream. Consequently Potomac River below the city is unspeakably foul. Cumberland is about 225 miles above the District water intake at Great Falls and although there undoubtedly is considerable purification, from a physical standpoint at least, taking place as the water runs from Cumberland to Great Falls, yet it has been amply demonstrated that it is not sufficient to render the water safe to use in its raw condition. The admirable report of the United States Marine-Hospital Service, transmitted to the United States Senate, March 26, 1898, shows that there is surprisingly little improvement bacteriologically in the stream as it flows from Cumberland to Great Falls.

North Branch turns sharply at Cumberland, flowing in from the southwest in a rather narrow valley, receiving on its way the waters of New and Georges creeks, besides others which are not of great importance in this investigation. At Keyser, situated upon the main stream, there is a public water supply, and town sewers empty into New Creek, while the sewage of the railroad station and that of the worsted company, together with spent dye liquor and wool scourings in large amount, go directly into North Branch. New Creek is decidedly polluted by the tannery situated upon its banks, 6 miles above Keyser.

Farther up are the towns of Piedmont and Westernport, both of considerable size, and above Westernport is Luke, where there is a large paper and pulp mill from which lime, clay, alum, and size are turned into the river. Georges Creek, which enters the main stream at Westernport, carries enormous quantities of acid mine waste, and when this mingles with the lime from the pulp mill at Luke there is a reaction which, although it makes the stream unsightly for about 3

miles, is ultimately beneficial to it. At Gormanian, still farther up the stream, is another tannery, while a second is located at Bayard.

Georges Creek, above mentioned, traverses the heart of the coal region and at times carries little else in its channel than coal-mine waste. The character of these polluting materials, together with statements concerning the points at which they are turned into the stream, and their principal effects, are discussed in the following paragraphs:

Coal-mine wastes.—This waste, commonly called "mine water," is usually a highly acid solution of lime, magnesia, iron, alumina, silica, and other minerals. It varies in its percentage composition in different coal fields, and indeed in the same mine, during the various seasons. It is absolutely destructive to fish life unless highly diluted and has important deleterious effects upon boilers and in many industrial processes. In fact, water polluted with mine wastes can not be used for such purposes without a high degree of damage. Upon sewage and other organic wastes turned into a stream it has a highly beneficial effect, and the acid which it contains neutralizes such industrial wastes as lime sludge and soda ash. In the Potomac River its effects are probably not deleterious on the whole.

The mining industry is probably the most important one of the Potomac watershed, the mines being located on the upper North Branch, the greater part of the waste flowing in Georges Creek. This creek joins the North Branch at Westernport, and the mine drainage finally reaches Cumberland where it has beneficial effects upon the sewage from that city. Although the effects of this waste are detrimental at some points in the upper drainage area, its effect upon the lower Potomac region is undoubtedly beneficial. The water supply of the District of Columbia is made much harder by reason of this waste than it otherwise would be, and it is possible that as the coal region is more extensively developed the hardening constituents in the water taken from Great Falls for domestic use in the District of Columbia will be increased to a damaging amount.

There is, however, apparently no redress in the case of this pollution because of the fact that mine water is a necessary consequence of the development of coal regions. A precedent in the case of coal-mine waste has been established by the supreme court of Pennsylvania, which held that as the contaminating material is a natural product and conducted into the stream in its natural state, mine operators are immune from injunction or damages. Inasmuch as mine waste has certain beneficial effects upon organic matter deposited in the Potomac, and as its undesirable effects upon the Washington water supply are somewhat remote, the matter need not give immediate cause for apprehension.

Wills Creek enters the North Branch at the city of Cumberland and above the dam across the latter which diverts water into the Chesapeake and Ohio Canal. About a mile above this dam, on Wills Creek, is another, which was constructed to divert a part of the Wills Creek water into a race, formerly a power canal, but now an open sewer, which empties into the Chesapeake and Ohio Canal. In low stages of water all of Wills Creek flows through this channel, thus leaving a mile of stagnant filth in the midst of the city of Cumberland into which the waste from slaughterhouses, sewers, steam laundries, tanneries, and breweries is turned.

Braddocks Run and Jennings Run are the two important tributaries of Wills Creek. On upper Wills Creek is the village of Hindman,

where there is a tannery, the refuse from which stains the stream a deep-red color, which persists all the way to Cumberland. Braddocks Run receives the sewage of Eckhart mines, and in the future will carry a large part of the mine waste from the coal regions. A tunnel is now being driven which when completed will divert most of the mine water from Georges Creek into Braddocks Run.

In the foregoing paragraphs the conditions are briefly related. It will now be necessary to consider their effects. In some parts of the Potomac drainage area nearly every water resource rightfully belonging to the stream is impaired or absolutely destroyed by the inconsiderate and wanton practices which prevail. As this communication is intended to set forth the consequences, present and future, to the public water supply of the District of Columbia, discussion of all other features will be omitted.

The most serious sources of pollution in the Potomac basin are at considerable distances from the Great Falls intake. They are not sufficiently far, however, to insure immunity from danger by reason of domestic use of water in its raw state. The biological evidence contained in the report of the Marine-Hospital Service, cited on a preceding page, proves this conclusively. The erection of the District filtration system, now nearly complete, is competent evidence that this fact has been recognized. There is, however, an improvement in the quality of the Potomac water as it descends from Cumberland to Great Falls. If it were not so, the water would not be a fit subject for purification. Dilution, oxidation, and sedimentation, forces which although not yet definitely understood are none the less effective, so improve the water that at Great Falls its reclamation offers few difficulties. Under the present conditions the filtration system will absolutely protect the District from serious consequences in the use of this water for domestic purposes. After the date of installation of the filter the real question will not be a present one. It involves considerations for the future.

In discussing future considerations it is necessary to bear in mind the fact that the foreign matter discharged into the Potomac is properly included in two general classes, sewage and industrial wastes. By sewage is meant the wastes occurring in the life processes of mankind and those resulting from domestic economy. Under industrial wastes are included all those products which occur as a result of any industrial process, and which, having no tangible value, are rejected. So far as the potability of the Washington water is concerned, these two classes of waste have separate and distinct relations to the Potomac River.

Sewage.—The primary object of the Washington filter in its proposed form is to remove sewage from the water, or, in other words, to remove certain germs of disease commonly contained in sewage. All other purposes are of secondary importance. If this purpose be accomplished (as it undoubtedly will be) the amount of sewage turned into the upper Potomac will, from a purely public health standpoint, be a matter of entire indifference to the residents of Washington. This assumption can not be extended indefinitely, for an increase in the degree of pollution in a water imposes a corresponding increase in the burden placed upon the filtration system. A highly polluted water may, within reasonable limits, be made practically as pure as a water containing only a small proportion of sewage.

The cost of purification is, however, increased accordingly. As the burden of a filter is increased the care and expense necessary to its

maintenance become greater and the liability of failure to purify becomes a constant menace. Accidents to the system and lapses upon the part of those in charge, which are sure to occur, be they ever so faithful, are not productive of serious results if the source of supply is only slightly polluted. If, on the other hand, the water is grossly contaminated, a similar failure of the system, even though it be temporary, will generally result in disease and death. Stated in another way, a filter provides a very wide margin of safety in the case of a slightly polluted water, but a narrow, uncertain, and expensive one in the case of a foul water.

Industrial wastes.—Far more difficult problems are offered by conditions of water pollution which arise by reason of industrial wastes than because of sewage. Such substances are usually more complex, more difficult of treatment, and have more varied unfavorable effects. The damage which they cause is economic as well as hygienic. Dangerous or troublesome characteristics are imparted to water which may not be removed by filtration. The subject is too extensive to review in this communication, as it involves the detailed consideration of all the industries from which wastes are derived. Certain wastes contain cumulative poisons which if taken into the system with drinking water will finally produce serious results.

A large number of wastes render the water hard, and thus become troublesome and expensive in steam boilers, in manufacturing industries, and in domestic use. Others impart tastes, odors, and colors to water and thereby render it valueless for domestic purposes. The effects of industrial wastes are various and in nearly all cases highly detrimental.

The final question for consideration is whether the conditions in the Potomac basin are such as to promise a more polluted condition of the river water than is now present. In the first place it should be stated that even at the present time there are occasional short periods when the character of the water passing Great Falls is such as to render its purification quite difficult. Such periods occur during floods, when the accumulated filth of the upper basin is brought down by the rush of water with a rapidity which admits of little or no purification on the way. Bearing this in mind, it will be instructive to examine the records of the United States Census Bureau concerning political and industrial development in the Potomac basin.

Place.	Population.		Per cent increase.
	1900.	1890.	
Cumberland, Md	17,128	12,729	33.9
Westernport, Md	3,258	2,401	35.7
Frostburg, Md	5,274	3,804	35.8
Ocean, Md	2,699	1,379	96.4
Ellerslie, Md	1,122	796	40.9
Eckhart, Md	1,658	1,478	12.2
Mount Savage, Md	2,645	1,978	33.8
Hagerstown, Md	13,591	10,118	34.3
Frederick, Md	9,296	8,193	13.4
Harrisonburg, Va	3,521	2,792	26.1
Staunton, Va	7,289	6,975	4.5
Front Royal, Va	1,005	868	15.8
Shenandoah, Va	1,220	751	62.4
Winchester, Va	5,161	5,196
Charlestown, W. Va	2,392	2,287	4.6
Martinsburg, W. Va	7,564	7,226	4.6
Keyser, W. Va	2,536	2,165	17.1
Piedmont, W. Va	2,115

POLLUTION OF POTOMAC RIVER.

Manufactures.

County.	Number of establishments.		Capital.		Employees.		Value of products.	
	1890.	1900.	1890.	1900.	1890.	1900.	1890.	1900.
Allegany, Md.....	147	250	\$2,055,094	\$6,375,175	1,717	4,035	\$2,746,588	\$6,909,342
Frederick, Md.....	372	353	2,065,913	2,386,588	1,798	1,833	2,514,292	3,108,929
Washington, Md.....	263	376	1,650,816	3,107,123	1,738	2,692	2,512,899	4,543,980
Jefferson, W. Va.....	49	94	792,282	1,156,795	355	503	445,272	934,493
Berkeley, W. Va.....	42	150	320,297	1,710,138	459	1,181	403,213	1,659,860
Morgan, W. Va.....	10	48	29,525	1,462,793	37	239	71,188	950,490
Hampshire, W. Va.....	42	75	247,974	351,284	128	109	374,891	659,133
Hardy, W. Va.....	8	35	10,725	229,945	9	45	22,236	325,517
Mineral, W. Va.....	35	57	428,321	1,270,888	585	734	685,577	1,296,949
Augusta, Va.....	200	155	1,152,277	801,078	893	541	1,586,949	1,201,848
Frederick, Va.....	126	75	828,218	182,722	809	130	1,061,997	293,841
Loudoun, Va.....	93	164	260,967	351,257	210	179	378,255	638,136
Page, Va.....	44	85	377,990	1,367,951	246	441	563,836	1,572,657
Rockingham, Va.....	186	227	677,331	1,241,482	525	566	969,367	1,881,779
Shenandoah, Va.....	74	144	178,637	358,791	172	182	278,148	777,274
Total.....	1,691	2,288	11,076,867	22,353,960	9,681	13,410	14,614,708	26,754,228

The tabulated statements above set forth show:

First. That population in the Potomac basin is increasing at a rapid rate in the larger cities, towns, and villages. Such growth inevitably leads to the construction of sewerage systems and many of the municipalities are looking forward to such installation. In a region where these conditions exist there is always a rapid sewerage development when once the movement is on foot, for civic pride and competition seem to be a controlling factor in municipal improvements. In this way the sewage pollution of the Potomac may be expected to increase enormously.

Second. In all of the Potomac basin counties noted above, except those of Augusta and Frederick, Va., there has been a consistent, and in some cases a remarkable, industrial development. Continued progress along these lines at a rate even more rapid is clearly evident. Therefore there is every assurance that the amount of pollution in Potomac River will increase if prohibitory steps are not taken. It is evident, too, that as soon as the Washington filter is placed in commission the restraint which now exists within certain areas in the upper valley with reference to the deposit of foul matter in the stream will be thrown off and the signal for promiscuous contamination of the river will be raised.

Wise and considerate prohibitory measures are necessary and should be enforced as soon as possible. If the problem is attacked now, when changes can be made by the municipalities and manufacturing plants without undue hardship, the work will be accomplished with far less trouble and expense than at a later date when the increasing foulness of Potomac River will make such steps absolutely necessary. Firmly established abuses require heroic treatment, especially when great expense is involved in their correction. Potomac pollution is now in its early stages; therefore prohibitory measures should be inaugurated at once.



Year	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930
Members	1,000	1,100	1,200	1,300	1,400	1,500	1,600	1,700	1,800	1,900	2,000	2,100	2,200	2,300
Publications	100	110	120	130	140	150	160	170	180	190	200	210	220	230
Revenue	\$100,000	\$110,000	\$120,000	\$130,000	\$140,000	\$150,000	\$160,000	\$170,000	\$180,000	\$190,000	\$200,000	\$210,000	\$220,000	\$230,000

The first of the two main purposes of the Association is to advance the science and art of medicine and surgery, and to improve the health of the people. The second purpose is to promote the highest standards of medical and surgical education and practice. The Association is organized into various departments and sections, each of which is devoted to the study and promotion of a particular branch of medicine or surgery. The Association also publishes a number of journals and books, and holds annual meetings and conferences. The Association is a non-profit organization, and its funds are derived from the contributions of its members and the sale of its publications. The Association is a member of the International Medical Association, and is in communication with the medical associations of other countries.

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