差的;此次调查结果,III 类住宅大为改善,而 I、II 类住宅两次调查结果近似(见图 3).

两次调查中 COHb 水平的绝对值是不可比的,因为前次调查中呼出气样品是在下班前于工作地点采集的,代表工作环境的接触量,而本次调查是采集于家中,更代表家中环境的接触量.

三、结　论

1. 北京地区三类有代表性住宅室内颗粒物和 CO 浓度均经常超标,以 CO 为甚,冬季突出.

2. 颗粒物的元素分析反映为典型的燃煤型和风沙的污染. 室内铅水平偏高可能与使用液化石油气灶具有关.

3. 居住条件与室内污染关系密切,但居住条件差别的关键是冬季采暖. III 类住宅恢复集中供暖前后之对比最为鲜明.

4. 在室内污染较严重情况下,吸烟因素的影响有时可被掩盖

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土壤吸铜特性对铜毒性临界值的影响

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摘要　本文选用四川紫色土共 8 个样品,进行了莴苣、辣椒的土培试验和 Cu 吸附试验. 结果表明,土壤吸 Cu 能力因土壤不同而异,吸 Cu 特征指数按红棕紫泥>紫泥土>夹砂泥>豆办泥>大土泥>红砂土>红紫泥>砂土递减. 高量 Cu 处理对莴苣、辣椒均有毒害,导致减产,不同土壤上 Cu 毒性大小的顺序正好与吸Cu特征指数相反,但是对于特定的作物都统一于平衡溶液浓度: 莴苣 $0.5\mu g/mL$,辣椒 $2.5\mu g/mL$,初步认为, 使用等温吸附方法估测作物 Cu 毒性临界值是可行的.

土壤中铜的迁移、转化及对生物(包括动、植物和微生物)的影响,不仅与其本身特性有关,而且受土壤组分对 Cu 的吸附-解吸、溶解-沉淀、络合等一系列物理化学过程的制约[1-3]. 迄今为止,有关 Cu 对生物的效应和 Cu 在土壤中的化学行为的研究报道已不少. 然而,大部分工作几乎都是分开来进行的,将二者联系起来,同步加以研究的报道尚不多见. 因此,本文选用四川省典型的紫色土样品,进行了莴苣、辣椒 Cu 毒性水平及 Cu 吸附作用的研究 并讨论了二者之间的关系,在此基础上,提出了一种判定土壤 Cu 毒性临界值的简便方法.

一、材料和方法

(一)供试土壤

土壤采自四川宜宾、重庆北碚及巴县等地紫色砂岩、泥页岩发育的紫色土,共 8 个土样. 风干,磨碎,备用. 土壤 pH 值用 1:1 水土比悬液、电位法测定;有机质含量用重铬酸

表 1　供试土壤的主要性质

土样编号	土　壤	地　点	pH	CaCO₃ (%)	有机质 (%)	CEC (me/100g)	全 Cu (μg/g)	质地
s_{01}	砂土	北碚	4.0	/	1.19	8.59	9.3	砂土
s_{02}	红紫泥	宜宾	5.2	/	1.01	12.0	11.0	壤土
s_{03}	红砂土	宜宾	5.1	/	1.63	11.0	12.1	轻壤土
s_{04}	大土泥	北碚	6.0	/	1.78	23.3	16.0	粘土
s_{05}	豆办泥	北碚	6.2	/	1.93	20.6	13.7	重壤土
s_{06}	夹砂泥	北碚	6.7	/	2.81	11.4	11.8	中壤土
s_{07}	紫泥土	北碚	7.8	11.2	1.48	14.5	18.9	中壤土
s_{08}	红棕紫泥	巴县	8.4	7.9	1.89	20.1	15.4	砾质壤土

钾法测定；CaCO₃ 含量用气量法测定；CEC 用加和法测定；机械组成用吸管法测定. 结果如表 1 所示.

（二）吸附试验

称取土样(<2mm)2.50g 于 100mL 具盖塑料离心管中，加入含有 0.01mol/L CaCl₂ 的 Cu 溶液 25mL(以 CuSO₄·5H₂O 配制，并调节溶液起始 pH 相等)，Cu 浓度分别为 1、5、10、20、30μg/mL 在 25±1℃ 条件下振荡 2h. 再放入 25℃ 的培养箱内保持过夜. 离心、分离上清液，用原子吸收分光光度计测定其中 Cu 浓度，以平衡前后溶液中 Cu 浓度变化计算土壤吸 Cu 量.

（三）盆钵试验

本试验分两部分进行. 一部分是用表 1 中 s_{03}、s_{05}、s_{06}、s_{08} 4 种土壤种植莴苣，土壤用 CuSO₄(A. R.) 处理. Cu 处理浓度为 0、10、50、100、200、300mg/kg，重复 4 次，各盆施相等的 N、P、K 量. 每盆栽莴苣 3 株. 采用随机排列. 历时 4 个月；另一部分是用其余 4 种土壤种辣椒，仍以 CuSO₄ 作 Cu 源，每盆 3 株，重复 3 次. Cu 处理浓度根据土壤吸 Cu 性能不同而有所差异：s_{01} 土为 0—200 mg/kg、s_{02} 土为 0—320mg/kg、s_{04} 土为 0—800mg/kg、s_{07} 土为 0—1450mg/kg. 培养 1 个月. 作物收获后，测定产量. 并烘干、磨细、过筛、测定植株含 Cu 量.

二、结果与分析

（一）紫色土的吸铜特性

土壤吸 Cu 等温线见图 1. 由图可见，土壤吸 Cu 量随液相 Cu 平衡浓度增大而增加. 在低浓度区，Cu 吸附量增加较快，在较高浓度区，Cu 吸附量增加变得缓慢. 这是由于在低加入量时，土壤固相有较多的吸附位供 Cu 占据，加入量增加时，吸附位渐渐被饱和，因而吸 Cu 量增加变缓. 根据曲线的位置相对高低，可将几种样品吸 Cu 情形分为三类. 第一类 (s_{07}、s_{08}土) 吸附量最大，在本实验条件下，吸附量是直线上升；第二类 (s_{04}、s_{05}、s_{06}土) 吸附量次之，低浓度区吸附量与平衡 Cu 浓度几乎呈正相关，土样间 Cu 吸附量差异小，与第一类较接近，但是较高浓度区，差异较为明显；第三类 (s_{01}、s_{02}、s_{03}土) 吸附量
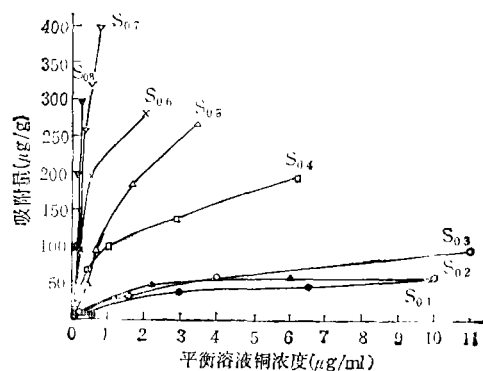
图 1　土壤的 Cu 吸附等温线

表 2　供试土壤的 C. I. 值

样品号 \ 加 Cu 量 (μg/g)	10	50	100	200	300	400	500	平均值
S_{01}	10.0	13.0	6.9	6.0	5.3	—	—	8.2
S_{02}	24.4	20.9	10.4	6.0	8.2	—	—	14.0
S_{03}	26.4	24.0	18.2	15.2	14.0	—	—	19.6
S_{04}	212.2	182.3	99.9	47.1	31.8	—	—	114.7
S_{05}	990.0	990.0	302.5	171.8	104.9	—	—	511.8
S_{06}	1240	990	545	390	139	—	—	661
S_{09}	275.7	1418	3323	4990	4990	—	—	2999
S_{07}	—	—	1101	1657	823	656.7	545.6	956.7

一开始就较低,且很快达吸附最大量. 看来, Cu 在不同土壤中被吸附固定的程度是不一样的.

土壤吸 Cu 过程实质上是 Cu 在固相-液相之间的一种分配. 因此,土壤吸 Cu 特征可用分配指数来反映,这里我们称作吸 Cu 特征指数,表达如下:

$$C.I. = \frac{s}{c} = \frac{R \cdot \gamma}{1-\gamma}$$

式中, $C.I.$ 为吸 Cu 特征指数 S 为土壤吸附量(μg/g); C 为平衡浓度(μg/mL); R 为液土比; γ 为吸附率.
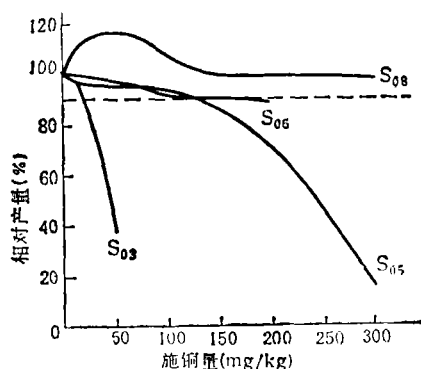

图 2　铜对莴苣地上部生物量的影响

$C.I.$ 值计算结果见表 2. 由此可见, $C.I.$ 值更加明确地反映了各土壤对 Cu 的吸附特征. 供试土壤 $C.I.$ 值大小顺序为 s_{03}(2999)>s_{07}(956.7)>s_{06}(661)>s_{05}(511.8)>s_{04}(114.7)>s_{03}(19.6)>s_{02}(14.0)>s_{01}(8.2).

$C.I.$ 值越大,即土壤对 Cu 的吸附能力越大,这意味着进入土壤的 Cu 存在于固相上的比例大,液相 Cu 较少. 当然,吸附于固相上的 Cu,在一定条件下,部分仍会解吸. 但总体来说,似可认为, $C.I.$ 值大的土壤中 Cu 的毒性相对较小.

（二）紫色土的铜毒性临界值

莴苣、辣椒 Cu 毒性水平试验结果见图 2、3. 结果表明,随着 Cu 处理浓度的提高,两种作物的生物量均表现下降, s_{05} 土上的莴苣在 50mg/kg 时下降 5%,100mg/kg 时下降 7%, 200、300mg/kg 时分别下降 30% 和 85%; s_{04} 土上的辣椒在 100、200、400、800 mg/kg 时分别减产 6%、13%、18%、21%. 这种下降率在不同土壤上存在很大差异,对莴苣而言,各土壤上减产率大小为 s_{03}>s_{03}>s_{05}≫s_{08}土; 辣椒的减产率是 s_{01}>s_{02}>s_{04}>s_{07}土. 这些结果与前面的吸 Cu 特性完全吻合.
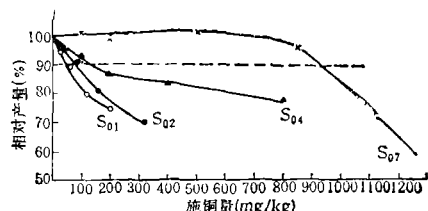
关于 Cu 毒性临界值的确定, 目前尚没有统一的依据. 植物从土壤中摄取过量的

图 3　铜对辣椒地上部生物量的影响

Cu,大部分积累在根部,向地上部分输送较少[4,5]. 由于根部受损,从而危害作物生长,影响产量. 故本文仍以减产 10% 作为确定紫色土上作物 Cu 毒性临界值的依据, 结果见表3.

表3　紫色土 Cu 毒性临界值 (mg/kg，加 Cu 量)

土壤	莴苣	土壤	辣椒
s_{03}	20	s_{01}	60
s_{05}	130	s_{02}	80
s_{06}	200	s_{04}	150
s_{08}	>300	s_{07}	940

从中看出,同一作物在不同土壤上,其毒性临界值差异极明显,最高与最低之差可达 15 倍以上. 但这种差异正好证实了不同土壤吸 Cu 特性有差异. 看来如果把一种土壤上获得的研究结果应用到另一种土壤上,这是不妥当的.

三、讨　论

铜进入土壤后,土壤组分便对 Cu 产生吸附固定作用,从而在一定程度上可使其毒性降低. 不同土壤对 Cu 的吸附作用不同,其大小顺序为 $s_{03} > s_{07} > s_{06} > s_{05} > s_{04} > s_{03} > s_{02} > s_{01}$. 莴苣受害情况是 $s_{03} > s_{05} > s_{06} \gg s_{08}$;辣椒是 $s_{01} > s_{02} > s_{04} > s_{07}$. C.I. 值大的土壤,施入 Cu 后,被吸附固定的比例大,残留在溶液中的 Cu 少,因而作物受害轻,毒性临界值大;相反, C.I. 值小的土壤,Cu 进入土壤后,大部分保留在液相中,其毒性临界值小.

我们知道,在土壤固相-土壤溶液-植物根系系统中,施入可溶性 Cu,土壤固相和植物根系都将争夺 Cu 离子, 二者争夺能力大小决定着 Cu 的去向. 对于同一作物,其根与 Cu 的作用力在一定时间内应是一定的,因而表现中毒时所需的土壤溶液 Cu 的强度、容量也应相同. 因此,不同土壤上,由于吸 Cu 特性的差异,作物中毒时所需的施 Cu 量就应有所不同,但是,土壤溶液中的 Cu 却应相近.

由于等温吸附试验中加入 Cu 相当于盆栽试验的施 Cu 量. 所以,我们以平衡溶液浓度对施 Cu 量作成图(图 4a、b),由表3的毒性临界值在图上反查得知:对于同一作物而言,几种土壤在平衡浓度上颇为一致,莴苣为 $0.5\mu g/mL$,辣椒为 $2.5\mu g/mL$. 我们将其称为 Cu 毒性临界强度指标,与此相应的土壤施 Cu 量则称为 Cu 环境容量.

综上看来,以生物试验的结果为依据,以等温吸附技术为手段来估测作物 Cu 毒性临界值是可行的. 但需指出, 这仅仅是一种尝试,还有待于进一步验证.
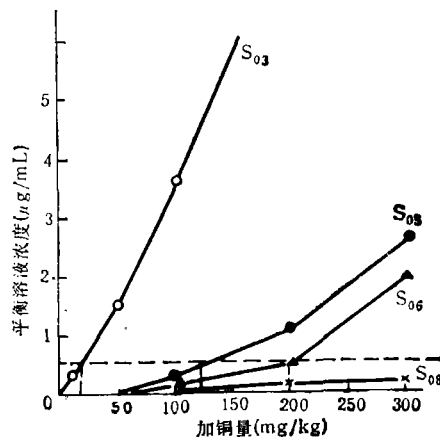
(a) 莴苣
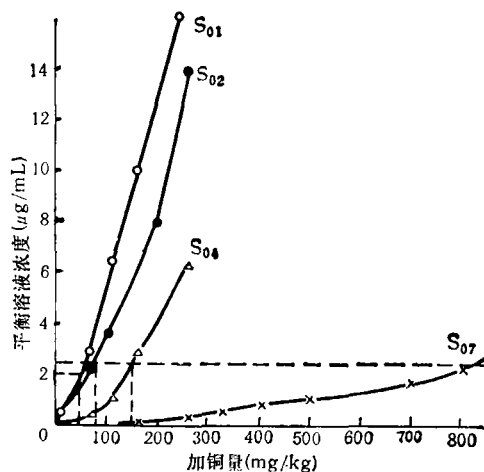
(b) 辣椒

图 4　土壤加 Cu 量与平衡溶液 Cu 浓度的关系

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旅游和城市化对避暑山庄土壤、植物的影响

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摘要　本文通过野外考察和采样分析,就旅游和城市化对避暑山庄土壤、植物的影响方式、程度以及采取的生态学措施进行了初步探讨. 结果表明,山庄土壤紧实度增加、孔隙度减少,碱度提高,硫含量是北京植物园土壤的 **2.1 倍**;植物遭受到人为引起的病虫害、机械破坏以及环境污染的影响,突出地表现在古松死亡严重(26.5 棵/年).

城市化破坏了自然环境,并对生物的生存空间产生影响. 关于城市化对土壤及植物的影响研究,国内外已有不少报道[2,4,5,6]. 旅游是风景名胜城市特有的现象,它一方面带来经济收入,另一方面由于人为活动增加,造成对生态环境的破坏. 开展以旅游为主的城市化对土壤及植物影响方式、后果及对策研究,对城市园林绿化以及合理开发旅游资源有重要意义,逐步引起人们的重视[1,3],但具体开展的研究工作还很少. 避暑山庄是我国现存最大的皇家园林,位于承德市区,土壤、植物受旅游和城市化影响造成了一定危害. 这项研究,旨在阐明城市旅游环境对植物的影响及其反应,以便采取相应的生态学措施,为创造优美清洁的旅游环境提供科学依据.

一、研 究 方 法

避暑山庄位于河北省承德市区 (E117°56′, N40°58′),其内分成宫殿、湖洲、平原、山峦四个部分,占地 560 公顷. 在植被调查的基础上,选择不同的游览区,进行土壤、植物样品采集,就下述几项内容进行了研究.

(1) 土壤理化性质　现场测定土壤容重,采集土壤样品测定含水量、比重,计算孔隙度,用 pHS-29A 型酸度计测定 pH 值.

(2) 植物样品采集分析　实地观察游览活动对植物机械破坏状况,选择避暑山庄分布最广的油松 (*Pinus tabulaeformis*)、羊胡子草 (*Carex rigescens*) 采集其叶子分析测定,用比浊法测硫,用 703 型石墨炉原子吸收法测铅,同时测定所采集土壤样品中的硫、铅含量.

(3) 古松死亡原因分析　选择古松分布的典型地段采样,分析土壤养分;搜集关于古松生长的水文、气候资料,进行古松生长势调查.

二、结果分析与讨论

(一) 旅游和城市化对避暑山庄土壤的影响

1. 对土壤孔隙度和酸碱度的影响

节日期间,来山庄游览的人数最多可达 15 万人次. 大批游人拥进山庄,对游览区土壤产生机械破坏作用,平原、湖洲、宫殿三区因游人多至,土壤被踏实,土壤容重大,而孔隙度小;山峦区游人少至,土壤受踏实不明

Treatment of Phenol-containing Wastewater by Immobilized Microorganism.

Zhou Ding, Hou Wenhua (Harbin Institute of Technology, Harbin): *Chin. J. Environ. Sci.*, 11(1), 1990, pp.

Treatment of phenol-cotaining wastewater by immobilized microorganism has been studied systematically in this paper. For this purpose, a strain of Canida tropicalis showing quite high phenol-degrading activity was separated from activated sludge. The immobilizing support and immobilizing conditions were selected through the experiments. The simulated wastewater containing 300 ppm phenol was treated in a self-made three-phase fluidized bed reactor filled with immobilized microorganism, and the outlet concentration of phenol was below 0.5 ppm. The volumetric loading rate of phenol increased by more than one time, and the amount of surplus sludge decreased by 90% as compared with those in traditional activated sludge method. These results show good prospect of immobilized microorganism in wastewater treatment.

Microbial Degradation of Polyethylene Farming-mulch-film after Its Photodegradation.

Li Fengzhen et al. (Institute of Applied Ecology, Academia Sinica, Shenyang): *Chin. J. Environ. Sci.* 11(1), 1990, pp.

This paper reports the conditions of degradable polyethylene farming-mulch-film by microorganism inoculation tests and soil-buried tests. The results obtained are as follows: 1. It is very difficult for polyethylene film of high molecular weight to be microbial degradation; 2. When the film molecular weight caused by photodegradation is below 4500—5000, the film fragments are susceptible to micribial attack by microorganisms commonly found in soil, and different microorganism has different degradability; 3. It is also demonstrated that photodegraded raoled fragments of polyethylene film with not inhibit soils oxidation metabolism and soil enxymatic activities.

The Joint Probability Distribution of Wind (Directions, Speeds) and Stability Coudition with the Diagnostic Depth of Planet Boundary Layer.

Xu Dahai (Chinese Academy of Meteorological Science, Beijing): *Chin. J. Environ. Sci.*, 11(1), 1990, pp.

In this paper, the joint probability distribution of wind (directions, speeds) and stability conditions are given on the basis of probability theory. A kind of semi-empirical formula is also obtained, and gives the diagnostic depth of planet boundary by using stability and the regular wind speeds measured on the weather station in China.

Study on Predicting Modle of the Nocturnal Radiant Inversion Distribution.

Zong Zijiu (Beijing Central Engineering and Research Institute of Non-ferrous Metallurgical Industry): *Chin. J. Environ Sci.*, 11(1), 1990, pp.

The height and strength of temperature inversions play an essential role in determining the dispersion of air pollutants. In this paper a new prediction modle of temprature inversion during night-time has been developed by modifying D. Anfossi and A. D. Surridge's methods, and three modified coefficients abount wind speed, aqueous vapour and temprature differences at groun have been given. The vertical temprature profiles obtained from the present modle have been compared with observations and the agreement is found to be better than previous models. The new modle can replace the method for measuring the temprature profile with balloon-borne thermosonde in the environment impact assessment.

Indoor Pollution of CO and Particulate Matter in Beijing and Its Elemental Analysis.

Wang Juning, Zhang Yue (institute of Environmental Health and Engineering, Chinese Academy of Preventive Medicine, Beijing): *Chin. J. Environ. Sci.*, 11(1), 1990, pp.

Three types of houses in Beijing were investigated that a smoking household and non-smoking one in each type were compared. Inhalable particulate (IP), respirable particulate (RP) and carbon monoxide (CO) were monitored in the living rooms and kitchens respectively for four seasons. At the same time carboxyhaemoglobin (COHb) was measured individually for each of the householders. The results showed that indoor air pollution was rather serious, especially in winter when particulate concentration was even as high as 47ppm. Indoor air pollution is closely related to types of houses, particularly to the ways of heating. Air pollution will be greatly decreased when central heating facilities are established.

The analysis of 30 elements showed that the pollution was typically derived from coal burning and aggravated by dust wind, but indoor higher Pb level was probably due to use of liquified petroleum gas for cooking. In our study, the effect of cigarette smoking seemed to be covered up by the serious indoor air pollution.

Influence of Cu Adsorption Characteristics on Cu Toxicological Threshold of the Vegetables in Purple Soil.

Tu Cong, Qing Changle (Lab of Agro-environmental Protection, Southwest China Agricultural University, Chongqing): *Chin. J. Environ. Sci.*, 11(1), 1990, pp.

Copper adsorption characteristics and its influence on the vegetable growth in purple soil collected from Sichuan Province were studied. The results showed that copper adsorption was dependent on the types of soil, and characteristic index of Cu sequentially decreased from No. S_{08} soil to S_{01} soil and has a great influence upon the vegetables. For a given crop, the same critical intensity index of copper toxicity could be obtained in different soil, e.g. 0.5μg Cu/ml of soil solution for lettuce and 2.5 μgCu/ml for cayenne pepper. It was concluded that adsorption method could be used to asses Cu toxicity threshold.

The Effects of Tourism and Urbanization on Soil and Plants at the Summer Villa, Chende City.

Jiang Gaoming, Huang Yinxiao (Institute of Botany, Academia Sinica, Beijing): *Chin. J. Environ. Sci.,* 11(1), 1990, pp.

In order to study the impact of both tourism and urbanization, the authors have investigated soil and plants at the Summer Villa, a former imperial garden in Chende City of Hebei Province. The results show that soil density and alkalinity have increased, and soil areation decreased. Sulphur concentration in soil is 2.1 times higher as in Beijing Botanical Garden, and plants have been injured by pests and pollution, for example, losts of old pine trees died in past few years. In addition, the authors proposed some ecological strategies to handle the problems.

Correlation between Fluoride Pollution in Air and Fluoride Contents in the Tree Leaves.

Dun Wanru et al. (Qingdao Municipal Institute of Environmental Protection, Shandong Province) *Chin. J. Environ. Sci.,* 11(1), 1990, pp.

Theaim of this work is to monitor quantatively fluoride pollution in air by detecting its content in the tree leaves. The result shows that the correlation between them is remarkable. Moreover, as fluoride content accumulating in the tree leaves in various periods has been determined, fluoride pollution in the air of the area can be assessed by application of the refression equation built.

Investigation of Contents of Total Mercury in Fishes in the Huluen Lake, Inner Mongolia.

Ha luen. Bai Shaoli and Xiao Tianmin (Research Institute of Environmental Protection of Inner Mongolia Autonomous Region, Huhehaote): *Chin. J. Environ. Sci.,* 11(1), 1990, pp.

The primary aim of this work is to investigatemercury pollution in fishes in the Huluen Lake, the larges fresh water lakein Inner Mongolia. Ninety fishes in nine species have been sampled from thelake. Data of total mercury in each fish with determination of cold atomicabsorption method are in range of 4.69—171.00 μg/kg, and average value 42.12μg/kg. Among the fishes, the highest content of mercury is in Barasilurusasotus (88.72 μg/kg), the second is in Cyprinus carpio heamalopterus (Tem) (75.35 μg/kg), and the next are Erythriculter mongolicus and Corassius. However, inrest five species of fishes, mercury contents are lower. In addition, themercury-accumulated contents in the fishes are consistent with their ages, lengths and weights.

Mechanism of Biological Removal of Phosphorus from Sewage.

Zheng Xingcan (Design Institute of Municipal Engineering of North China, Beijing): *Chin. J. Environ. Ssi.* 11 (1), 1990, pp.

The paper briefly summarizes the work on mechanism for enhancing biological removal of phosphorus. Release of phosphate from sludge primarily depends on the nature of substrate interacting with the poly-p bacteria, not on creation of an anaerobic state per se. In the anaerobic state, the readily biodegradable soluble COD can be converted to terminal products (acetate and $NADH+H^+$) of EM pathway by acidogenic microflora. The accumulated $NADH+H^+$ Will stop the EM reaction and/or kill bacteria. Poly-p bacteria will utilize poly-p for energy to absorb these terminal products and convert them into poly-β-hydroxybutyrate (PHB) in cell. The phosphate release takes place at the same time. In the presence of oxygen (or NO_3-N) PHB will be degraded to produce energy. The energy can be used for phosphate uptake and poly-p synthesis. The magnitude of phosphate uptake is proportional to that of anaerobic phosphate release (2.4 mg P uptake/mg P released).

Determination of Uranium Contents in Tap Water of Lanzhou City and in Mineral Water of the Wuquan Mountain Using Fission Track Method.

Yang Huazhong, Chen Huailu (Dept. of Modern Physics, Dept. of Geography, Lanzhou University, Lanzhou): *Chin. J. Environ. Sci.* 11(1), 1990, pp.

This paper describes how the fission track method was used for determinating uranium in tap water and mineral water sampled from Lanzhou and the Wuquan Mountain respectively. The natural uranium concentration were calculated in absolute and relative measurements. The quantitative difference of both results obtained was 3.6%. The concentration range of uranium calculated with the absolute measurement was $4.4-7.4 \times 10^{-6}$ g/L, and the total experimental error was within 10%. The uranium concentration in mineral water is higher. Compared with uranium concentration in tap water of Beijing,