ナイジェリア・ジョス大学医学研究プロジェクト計画打合せ調査報告書

昭和60年2月

国際協力事業団
医療協力部

ナイジェリア・ジョス大学医学研究プロジェクト計画打合せ調査報告書

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はしがき

本ナイジェリア国ジョス大学医学研究プロジェクト（協力期間：昭和57年7月2日－昭和62年7月1日）は，これまでの協力期間前半期において，長期専門家の派遣を軸に活動の基礎固めに努めてきたところであり，活動基盤が除々に整備されるにともない，昭和59年度からは，新規の長・短期専門家の派遣による技術移転活動も本格化しつつある。他方，それとともに，「協力内容」及び協力活動を支える「協力体制」の両面において，プロジェクト発足時に比して，より詳細な話し合いを行う必要が生じてきた。

当事業団はかかる認識のもとに，昭和59年11月12日より同月26日まで，大志摩毅国内委員を団長として計画打合せ調査団を派遣した。本書はその報告書である。

ここに，調査団に参加され，調査，協議及び指導にあたられた調査団員各位並びに平素より本プロジェクトに御協力を賜っている関係機関各位に対し謝意を申しのべるとともに今後とも本プロジェクトに対し御協力御支援を頂きたくお願い申し上げます。

昭和60年2月

国際協力事業団
理事　中平　立

目　　次

I　調査団構成及び調査日程

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調査団構成

団　長	大志摩　毅　（おおしま　たけし）
団　員	溝　口　勲　（みぞぐち　いさお） 東京都立衛生研究所環境保健部長
団　員	岡　村　登　（おかむら　のぼる） 東京医科歯科大学医学部微生物学教室助手
団　員	伊　藤　清　臣　（いとう　きよおみ） 国際協力事業団医療協力部医療協力課長

調　査　日　程

日　時	日　程
11月21日（月）	
17：30	箱崎ＴＣＡＴ集合
21：30	ＫＬ８６８　成田発
11月13日（火）	
06：05	Amsterdam 着
08：30	Sonesta Hotel　投宿
11月14日（水）	
11：20	ＫＬ 577　Amsterdam発
17：50	Lagos 着吉本洋二書記官出迎え
23：00	EKO　Hotel投宿
11月15日（木）	
09：00	宮川　渉大使表敬
10：00	国家計画省表敬　（T. A. Orkoga, Principal Secretary, 局長）
14：00	大使館打合せ

11月16日（金）

15：15	WT３０２　Lagos発　木元職員見送
16：20	Jos着　（但し発着は予定より１時間遅延）
19：00	Guest House投宿

11月17日（土）

10：00	携行品開梱　於Guest House
14：00～17：00	日本側関係者打合せ　於高橋リーダー宅

11月18日（日）

08：00～18：00	Bauchi, Yankari視察

11月19日（月）

00：30～10：30	Jos大学医学部Oji教授表敬及び打合せ　於　医学部長室
13：00	生化学教室視察及び会合
15：30	計算機室
19：30	医学部長招宴

11月20日（火）

09：00	微生物教室及び病院検査室視察
11：00～12：30	微生物関係会合
13：30	ＪＩＣＡ　昆虫グループ実験室視察
14：30～16：30	昆虫・寄生虫関係会合　於　昆虫学教室

11月21日（水）

09：00～13：00	Binchi地方視察
14：00	全体会議(1)　於　医学部Board Room
14：30	E. U. Emovon学長表敬
15：00～16：30	全体会議(2)
19：30	調査団長招宴　於　Hill Station

11月22日（木）

09：05	WT３０１　Jos発
10：10	Lagos着　木元職員出迎え
12：30	EKO　Hotel　投宿
14：00	大使館報告，資料整理
19：30	大使招宴　於　公邸

11月23日（金）

08：00～20	Ife大学保健科学部視察

11月24日（土）

11:30　　BR374　Lagos発　吉本書記官見送り

17:05　　London（LGW）　着

19:00　　London Forum Hotel 投宿

11月25日（日）

14:30　　JL422　London（LHR）

11月26日（月）

17:20　　成田着　解散

Ⅱ　総　　括（大志摩　毅）

II 総 括（大志摩毅）

今回の調査団の目的は

① National Planningの事務に時間のかかることの原因

② JOSの専門家の研究及び日常生活の状況

③ 今年度中に中間報告を印刷する計画の実施の可能性と内容

が主で，JOS大側の要望（機材）及びCounterpart 日本派遣計画の実状を見ることが加わると思われる。これらには根本的にNigeriaとの親善があることは勿論である。

①についてDeputy SecretaryのAkinboboyeが不在で，Principal Secretary のOlukoyaを表敬した。親愛の情を示している様で事務の遅れはNigeriaの通例であり，今後とも充分の時間的余裕をもって処するべきであろう。

②4つのGroup Planの活動は盛であり，短期の方々の研究・指導も熱心であり，成果は期待可能である。日常生活はひどいインフレに一般人も日本人も苦しんでおられることがはっきり判った。

③12月中に原稿が集まり，1月10日（正月あけ）までに日本に送附されることがGeneral Meetingで決った。

JOS大側の要望は新医学部長 Oji（眼科教授）の纏める能力に依る。充分な能力のあることは諸種の状況で判明したので，各人の要望を考え予算の範囲内で実施するのは困難は多い様だが可能性はある。万一合理性が認められない場合は東京側で調整決定することも考えられる。これは高橋Leaderの意見を聞かれて行なわれるべきと思う。理由の一つとして，派遣専門家の立場を悪くしない配慮が必要であるからである。

供給物資の決定后，出港まで3ケ月，船が1ケ月余，港は空いているので荷揚は早いが陸上輸送はどの位時間がかかるのかJOS大の予算執行にかゝるので予測出来ない。今年は大体のものが2－3ケ月でJOSに着いた。

Counterpartの Jos 側の決定は学内の協力分配で決まるらしい。理学部長 Ejikeと医学部長 OjiにEmovonが（Ikemeも）advice するらしい。

V－C, Emovonは多忙のところをbye－bye Party にまで来られたので，派遣専門家の涙ぐましい努力に充分応えている感じであり，調査中の日本医師の診断行為は問題がないと明言した。

以上，多大の成果は何もないが，一応の目的は達せられたと思うので報告する。

Ⅲ　調査・協議結果概要

Ⅲ　調査・協議結果概要（伊藤清臣）

A．在ナイジェリア日本大使館（11月15日（木）　9：00～10：00）

表敬：宮川渉大使，吉本洋二書記官

1. 現行Jos大医学部プロジェクトは3年目の見直し時期であるが，当初の予定協力期間5年間は継続することとする。
2. 新期案件については，大使館の情報を外務本省に伝達するに留める。

B. 国家計画省（11月15日10：00～11：00）

表敬：T.A. Orkoga局長（Principal Secretary）

1. JICAの組織，事業についての紹介用小冊子を示し説明。
2. Jos大医学部プロジェクトについての説明。
3. 事務手続の遅延，特に各種要請書の発出と機材引取についての円滑化を依頼。
4. 同局長は新任のため，余り具体的な話合いが出来なかったが，双方なごやかな対応であった。
5. アルハジ次官，アキンボボエ課長は不在で面会出来なかった。

C. プロジェクトサイト

1. 日本人専門家との打合せ（11月17日，14:00～17:30 於　高橋リーダー宅）
   a. 分野別実績報告（巻末資料1.2.3.参照）
   b. 将来計画（案）検討－野外調査計画－
      1）時期：1985年6月
      2）場所：Binchi或はZagun村周辺の100～150人規模の集落を2～3個所選定
      3）調査項目及び必要人員

	「ナ」側	日本側
甲状腺異常	医師　1名	医師　1名
	補助者　1名	
腸内細菌	採便者　1名	医師　1名
	補助者　1名	技師　1名
マラリア	採血者　1名	
	補助者　1名	
尿	採便者　1名	
オンコセルカ	採取者　1名	医師　1名
盲　目	眼科医　1名	
飲料水等		

4）問題点

1）事業主体：Jos大学の事業として協同で当り，住民の協力，人員の確保を図る。

2）計画→実施→分析→解析→対策の各案は行政機構（州衛生当局）に提示して協力を求めるとともに，調査結果の有効活用を図る。

3）患者の治療：「ナ」側に行わせることとし，日本側は関与しない。

4）腸内細菌：現状の検査体制の不備等野外調査施行以前に解決すべき問題も多いのであらためて検討を要する。

c. 中間報告書作成

1）これまでにまとまった報告の出ているものもあるが，あらためて各分野別に実績をまとめ，あわせて将来計画についても詳述することとする。

d. 一般情況

1）電気，水がとまることは非常に少くなった。大学の発電機の稼動状態が良くなったことと工場の操業率が下ったことに依るものと考えられる。特に午前から午后3時頃までは問題がない。

2）今年度の新規工事予算は全て削除されているので，医学部の移転計画も大幅に遅れる見込である。

2. 全体会議 （11月21日，14:00～16:30 於 医学部 Board Room）

出席者：

Prof Oji	（医学部長）
Prof Anekwe	（生化学）
Dr Nwene	（地域保健）
Mr Shonekan	（微生物）
Dr Kozak	（ 〃 ）
Dr Kumar	（ 〃 ）
Prot Iwuala	（衛生昆虫）
Dr Robert	（ 〃 ）
Dr Isichei	（臨床病棟）

a. 1985年度分供与機材要請案

1）11月末に各分野別にまとめ 優先順位を附して医学部長，高橋リーダーに提出する。

2）全体調整后日本側に手渡す。

b. 分野別報告

1）Endemic Goitre （巻末資料1－(2)参照）（P.82）

2）Trace Element （ 〃 1－(1) 〃 ）（P.16）

(1) 実験室拡張計画

(ii) 電源容量の増大計画

3) Microbiology （巻末資料 1 −(3)参照）（P. 89）

4) Entomology （ 〃 1 −(4) 〃 ）（P. 115）

(i) 課題数を11から13に拡大

(ii) 野外調査用の車の要望が非常に強い。

c. 全体調整

1) 複数学部にまたがるため，調整機関として Subhead Meeting を開催する。

2) 分野別中間報告を「日」−「ナ」双方の関係者がまとめ，11月末に打合せ会議を開催する。更に12月中旬には日本側に手交する。

d. その他

会議記録は浄書後日本へ送付する。

Ⅳ　調査報告（各論）

Ⅳ 調査報告（各論）

A. 生化学部門 （溝 口 勲）

RDのMaster Plan，「協力の第1年度～第3年度に飲料水，食品の検査研究を行う」にもとずいて，機材としては原子吸光分光々度計，イオンクロマトグラフイをメインとした供与を行ない，長期専門家として野田千代一，短期専門家として都衛研笹野英雄副参事研究員（2回），同じく土屋悦輝主任研究員が派遣された。

Counterpartとしては Dept. Biochemistryの Head Dr. K. K. Sen. Senior Lectuer. Dr. G. A. Ubom及び Dr. Z. S. C. Okoye. Technologist. Mr. P. Dayakであるが，実質的には野田－Ubomが飲料水，Dam，河川水，泉井水のTrace Metal及び無機イオンの測定を行っている。検査項目は Sn, Mg, Ca, Pb, Mn, Cu, Na, K, Zn, Fe, Cdの11元素および SO_4^{--}, NO_3^-, NH_4^+, I^- 等である。

採水地点としては Jos 市内の水道源水，浄水に加えて，Lamingo Dam, Liberty Damや，Assob River，Bakuru tin Mining, Well 及び Tap Water，甲状腺腫の見られるBinchの井水等数10ケ所に及んでいる。雨季，乾季による変動までの検討には到っていないが，数多くのデータがすでに出されている。その中には，Assob River での工場排水などで Fe, Cu, Mgなど極端に高い数値（ppm～数10ppmオーダー）が数検体でており，今後さらに種々の条件で採水し検討を要すると思われる結果も含まれている。

ヨードに関連しては飲料水中には ppb のオーダーでは全く検出されていない。

尚水中でのHg, Asの検索については今後試薬及び技術の習得を行った上で実行される筈である。

Counterpartである NigerianのDr. G. A. Ubomは本年10月より2ケ月余，都立衛生研究所で主として水中の微量成分の分析の研修を行い12月18日離日するが，本協力研究のCounterpartとして，それなりの意欲と責任感を持っていると思われる。また本年9月末ラゴス大学生化学教室 Senior Lecturer であった Dr. Anekye (Nigerian)が Jos大学生化学教室に教授として着任し，今までの教室 Head であった Dr. Sen(Indian)に変われものと思われる。

野田千代一専門家が本年6月帰国するが，それまでには，飲料水河川水，ダム，その他Jos 地域の水中微量重金属の濃度及び変動についてのデータの取りまとめは可能であると判断される。

生活排水処理は極めて未発達であるので，水中でのアンモニア量が可成り高いと予想され（イオンクロマトでのデータは今後出てくると思われる），水処理での塩素使用によってクロラミン，トリハロメタン等の発生も考えられる。

今後もし，Jos 大学でのこの分野での調査・研究の展開に一定の支持が与えられるとすれば，

1. 穀物や野菜等の食物，生物，人髪等でのTrace Metal分析（試薬類のみ必要）
2. クロラミン，トリハロメタン等の飲料水の安全性への調査検討（ガスクロマトグラフィ 供与の必要性あり）
3. Endemic Goitreとの関連での食品中のI^{+}の定量（試薬供与のみ必要）

等が考えられる。特に長期の専門家の派遣は必要ではなく，短期専門家の2回～3回程度の派遣で計画は進行可能と判断される。

B. Goitre 疫学部門

RDのMaster Plan「協力の第1年度～第3年度に甲状腺腫の検査研究を行なう」にもとづいて，短期専門家として東大田中恒男教授，西垣克助手（2回）が1984年度にJos大学に派遣され，Counter partとしてJos大学Dept.Cnmmnity Medicine，Prof. Tiwari（Indian）を中心として甲状腺腫の調査が行われた。

Prof Tiwariは，Jos周辺のBinchiなど4村落の学童を対象とした疫学調査を行ない，20～40%に及ぶ甲状腺腫の有症率のデータをすでに作っている。日本では見ることが出来ない巨大な甲状腺腫から，若干の甲状腺肥大の程度までであるが，片側のみの巨大な甲状腺腫もあり，その疫学的な調査には今後いくつかの改善点があるように思われる。この点に関しては田中恒男教授のProf. Tiwariにあてた詳細なRecommendationがあるので，ここで再述はさける。（巻末資料2参照）

WHOのEndemic Goitreに関するReportが示すように食品中のI摂取量の不足が主たる問題と考えて大過はなかろうが，巨大な甲状腺腫をもつ患者群の食生活を中心とした生活調査，家族調査など残されている課題は大きい。水中のTraceMetalと分析などとCo-opして，食品中のI分析は可能性はありそうである。

このテーマで最大の問題はProf.Tiwariが離任してインドに帰国してしまっており，Nigerianでしっかりしたcounterpartが現在いないことである。良いCounterpartを見出すことが不可能であり，JICAからの短期派遣専門家のみによるとするなら，Prof. Tiwariの疫学調査をBaseとしてBinchiその他のフィールドにおける包括的なCase Studyを小数例についてでも行ない，そのEtiologyにより迫ることが実現可能のある課題となるかも知れない。

C. 小児下痢症部門 （岡 村 登）

1. 現時点までの成果と総括

A) 投入実績と問題点

イ. 機材供与：供与した機材は，備品についてはそのほとんどが稼働しており，消耗品も定期的に使用されていた。必要な機材はほとんどが投入され，あとは消耗品の補充で十分であると思われた。時々ある停電による冷蔵庫・ふらん機などの停止はある程度克服されており，研究上の大きな障碍にはなっていない。

2. 専門家派遣：長期専門家の高橋・才田氏はいろいろな困難を克服して，ＪＩＣＡ の研究室を整備し，十分な細菌検査が可能な体制となった。短期専門家の谷口博士はロタウイルスの検査技術を直接指導した。また今川博士はプロジェクトの運営，特に小児科および Outpatient Clinicの医師との協力について改善させ，データ処理について適切な助言を行った。

3. 研修員受入れ：現在までのところ小児下痢症のプロジェクトからは研修員を受入れていない。

B. 産出実績と問題点

1. 施設整備：Ａ－２でふれたように，高橋・才田両氏により整備され，現在の検体数に対して十分対応が可能である。しかし，今後検体数および検査項目が拡大すると，現在のスペースでは足りなくなる可能性がある。

2. 人材育成：高橋・才田専門家のカウンターパートとして現地の Medical technologist を受入れた。高橋・才田両氏の指導により十分な検査技術を修得した。

3. 研究実績：主として大学病院の患者，乳児健康相談所よりの材料について検査を行い，589 検体について，Campylobacter（8.8％），Shigella（8.5％），enteropathogenic Eschenchia coli（6.1％，enterotoigenic E.coliも含む），Salmonella（2.9％）を分離している。ロタウイルスについては本年８月より検査を開始し，141検体から3.5％の陽性者を見出している。本研究に関しては，本年６月に Jos大学で開かれたウィルス・ワクチン学会，11月に Nusskaのナイジェリア大学で開催されたナイジェリア微生物学会でそれぞれ発表している。更に患者の生活環境についても調査を行っている。以上の研究により，Jos市の下痢患者の寄生虫学的・細菌学的概況を一応知ることが出来たと考えられる。問題としては，これらデータが厳密な意味での疫学的なデータとはなっていないことである。また下痢をしていない健康児の保菌状態も調査する必要がある。下痢患者よりの病原体の検出率が低い点も，検体の採取・輸送の改善，治療前の糞便の採取などにより改善されるのではないかと考えられる。

II. 今後の運営方針

A) 到達目標の確認：ロタウイルスの検査が軌道にのったので，小児下痢症の総合的解析が可能になった。この研究を一定程度集積し，またage-matchedの対照群を同時に調査して年間の季節変動など多くの解析を行う。また問診票のデータをコンピュータに入力して解析を容易にする必要がある。

B) 目標達成に必要な投入計画

1. 専門家：細菌検査に関しては長期専門家の高橋氏がいるので大きな問題はない。また才田氏の後任として高橋（利幸）氏が決定した。少なくとも一年間は滞在の予定であり，コンピューターにくわしいので大きな力となると考えられる。短期専門家については，プロジェクトの運営を改善することのできるadministratorとして必要であ

ろう。

2. 研修員：現在，長期専門家の高橋氏は Counterpart medical technologist の日本での研修と考えているようであった。

3. 機材供与：現在のところ機材は一応整っているので，消耗品の補充で十分であると考える。

III. プロジェクト管理運営体制

小児下痢症のプロジェクトの管理運営体制にはいろいろ問題点が多かったようであるが，現在は少しづつ改善されつつある。最大の問題点は，臨床の場での患者の選択・適切な採便，および診断名を含めた患者に関する情報などが，的確に把握できないことである。このことは疫学調査という点では大きな弱点であると考えられる。各セクションが責任をもってその任務を行い，総括できる強力なadministratorが必要であると考える。

D. 衛生昆虫

衛生昆虫分野については調査団員に当該分野の専門家が含まれていなかったこともあり，詳細は現状報告は調査団派遣時期に現地に派遣されていた角坂照貴専門家（愛知医科大学）の報告（巻末資料4）に譲る。

資　　料　　編

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SECOND ANNUAL REPORT - DECEMBER 1984

University of Jos/Japanese International Cooperation Agency Research Project.

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1) Following the signed Agreement of the University of Jos/JICA Research Projects, the members of the Japanese Team arrived Jos in October 1982 and research began on the various sub-groups of the research projects.

The first Annual Report of these Research Projects was compiled by Professor A.C. Ikeme in December 1983. This volume is the Second Annual Report incorporating the preliminary reports of December 1983 and the mid-term results from January 1984 to December 1984.

Sub-Group (1): Project: Trace Element Analysis

(a) Dr. G.A. Ubom and Mr. C. Noda- Preliminary report on the trace elements detection in natural sources in Plateau State, Nigeria.

(b) Prof. C. Ejike, Dr. D. Anadu and Dr. J. Chidobem - Distribution of trace Elements in some surface waters.

(c) Mrs. M. Adiuku-Brown and Dr. A. Ogezi - Comparative sample de-composition techniques for the analysis of simple sulphide minerals.

(d) Dr.A.E. Ogezi, Mrs. M.E. Adiuku-Brown and Dr. M. Alam- Environmental and economic studies of trace elements associated with mining and mineral processing in parts of Plateau State, Nigeria. a preliminary report.

Sub-Group (2): Project - Goitre

(a) Prof. I. Tiwari and Mr. M. Okoronkwo - JICA/UniJos project on endemic goitre.

Sub-Group (3): Project - Diarrhoea

(a) Dr. W. Kozak and Mr. R. Shonekan - Bacteriological investigation of diarrhoea in children.

(b) Miss. A. Ani and Mr. M. Takahashi - Aetiological studies of infantile diarrhoea disease seen in Jos University Teaching Hospital. A preliminary report.

(c) Dr. U.P. Nwene - Date on clinical presentation and socio-demographic profile of diarrhoeal cases.

Sub-Group (4): Project - Medical Entomology

(a) Prof. M. Iwuala, Mr. Maduabun and Dr. H. Takahashi.- Study of distribution of black flies (Simulium species) on the Jos Plateau

(b) Dr. D. Roberts and an MSC student - Effect of water velocity on the relative abundance of immature black flies

(c) Dr. D. Roberts, Mr. D. Boakye and Mr. J. Ogidi - Effect of temperature and humidity on black fly pupal survival

(d) Dr. R. Irving-Bell and Mr. I. Sessay - Distribution of immature mosquitoes associated with two riverine sites.

(e) Dr. R.J. Irbing-Bell and Mr. I. Sesay - Mosquitoe breeding habitats: Distribution and relative abundance of species at a Kagoro forest stream in Northern Nigeria.

(f) Dr. C. onwuliri, Dr. I. Lawal and Mr. B. Nwoke - Prevalence of distribution of onchocerciasis on the Jos Plateau.

(g) Prof. M. Iwuala, M. M. Maduabum and Dr. H. Takahashi - Study of the seasonal abundance and population characters of immature stages of black flies in the Jos Plateau area

(h) Dr. D. Robert s and Mr. J. Davis-Cole - Effect of predators and type of substrate on the relative abundance of immature black flies.

(i) Dr. D. Roberts and Dr. Irving-Bell - Dispersal of Adult black flies

(j) Dr. R. Irving-Bell - Niche distribution in relation to physiological state of adult populations of black flies and mosquitoes.

The Faculty objective of identifying the health needs of the population and providing solutions to these is continually kept in mind and in these research. Expansion of the research to include other Faculties, we feel will provide a broader base for data acquisition for the solution of these problems.

24, December 1984.

Revd Prof. E. O. Oji
Dean, Facul;ty of Medical Sciences

PRELIMINARY REPORT ON THE TRACE ELEMENTS DETECTION IN NATURAL SOURCES IN PLATEAU STATE, NIGERIA.

Gregory Abraham UBOM and Chiyoichi NODA
Department of Biochemistry, Faculty of Medical Sciences, University of Jos

This report is a summary of work and data collected by the Biochemistry Department, Faculty of Medical Sciences, as part of the participation in the JICA project up to the period ending December 1984. The cationic concentration data were obtained using the Atomic Absorption Spectrometer(AAS) which was succesfully installed and tested in the Department by November, 1983. The Anionic levels-studies were performed with the Ion Chromatographic Analyzer(ICA) which was installed in the Department around June, 1984. The remaining data - total organic carbon (TOC), soluble silicates (SiO_2), ammonia (NH_3) etc, were determined using the facilities at the Tokyo Metropolitan Research Laboratories of Public Health by Dr. Ubom during his JICA sponsored leave in Japan between October and December, 1984.

Table 1 and 2 are comparative cationic and anionic concentration data on water samples from goitrous and non-goitrous locations.

Table 3 shows the trace and heavy metals composition in water samples collected from chemically treated(tap) and untreated sources (streams, wells, dumps and industrial effluents) and Table 4 is the organic and inorganic composition of water samples collected from different locations of Jos Metropolis.

The observation in all cases of analyzed waters is that water whether treated or untreated is soft (ie. low in Mg^{++} and Ca^{++}). The quality of water analyzed is generally good and falls within the internatioally specified limits with the exception of high iron concentration in some industrial runoffs. The organic components, oxygen (Biochemical and chemical)demands, disinfectant quality of these waters should be monitored in order to be able to make broader assesments of the water.

Table 1. Anions, trace and heavy metals concentrations in waters at the Goitrous villages.

unit: I ug/l, rest mg/l

LOCATION		I^-	F^-	Cl^-	NO_3^-	NO_2^-	PO_4^{3-}	Br^-	SO_4^{2-}	K	Ca	Mg	Na	Zn	Cu	Fe	Mn	Cd	Totall hardnes
ASSAK	(ST)	0.5	0.1	0.5	0.0	0.3	0.0	0.0	0.6	0.7	0.2	0.1	1.3	0.011	0.002	0.45	0.016	0.000	0.9
BIMBOP 1	(W)	0.0	0.1	0.6	0.0	4.4	0.0	0.0	1.2	4.1	2.5	0.2	4.2	0.005	0.001	0.37	0.050	0.000	7.1
BIMBOP 2	(W)	0.0	0.7	14.2	0.0	52.6	0.2	0.0	9.1	3.6	17.9	1.6	8.1	0.000	0.000	0.70	0.023	0.000	51.5
BINCHI 1	(W)	0.0	0.3	0.9	0.0	1.9	0.2	0.0	1.2	2.1	4.3	2.7	8.3	0.012	0.006	0.54	0.062	0.002	22.2
BINCHI 2	(W)	2.4	0.2	3.6	0.0	0.1	0.0	0.0	6.9	7.1	24.5	2.2	8.8	0.018	0.000	2.75	0.141	0.000	70.6
DUTSENKURA	(ST)	0.0	0.1	0.2	0.0	1.7	0.0	0.0	0.4	0.6	0.2	0.1	1.4	0.000	-	0.15	0.009	.0.000	0.9
IBANDI	(ST)	0.0	0.2	0.7	0.0	0.3	0.0	0.0	0.4	1.3	1.0	0.9	2.9	-	0.000	1.60	-	0.000	6.4
KISANCHI 1	(SP)	0.0	0.2	1.7	0.0	0.9	0.0	0.0	1.7	1.1	3.1	1.4	7.9	0.003	0.000	0.45	0.014	0.000	13.7
KISANCHI 2	(W)	0.0	0.2	3.9	0.0	0.5	0.2	0.0	1.0	2.5	2.9	1.1	6.0	0.005	0.000	0.50	0.027	0.000	11.9
KISHI-II 1	(W)	0.0	0.3	3.0	0.0	9.7	0.5	0.0	2.2	2.1	3.2	0.9	8.3	0.014	0.000	1.03	0.028	0.002	11.8
KISHI-II 2	(W)	0.0	0.2	6.7	0.0	3.9	0.5	0.0	0.6	2.3	3.1	0.5	8.2	0.010	0.000	0.57	0.018	0.000	9.9
Mean		0.3	0.2	3.3	0.0	6.9	0.2	0.0	2.3	2.5	5.7	1.1	6.0	0.008	0.001	0.83	0.039	0.000	18.3

Note: Figures are average of 2-5 tests.
ST-stream
W-well
SP-spring

Table 2. Anions, trace and heavy metals concentrations in waters in Jos area

unit: I^- µg/l, rest mg/l

Location		I^-	F^-	Cl^-	NO_2^-	NO_3^-	PO_4^{3-}	Br^-	SO_4^{2-}	K	Ca	Mg	Na	Zn	Cu	Fe	Mn	Cd	Total hardness
DOGONDUTSE	(W)	0.0	0.2	1.5	0.0	4.5	0.0	0.0	1.1	1.5	0.1	0.1	4.0	0.008	0.000	0.05	0.013	0.003	0.7
JARAWA	(W)	2.7	0.1	4.2	0.0	14.1	0.0	0.0	1.0	2.9	1.8	0.3	6.9	0.020	0.000	0.19	0.036	0.000	5.8
JOS RIVER	(R)	0.0	0.1	1.1	0.0	1.5	0.0	0.0	0.7	1.5	0.2	0.1	2.3	0.005	0.000	0.19	0.004	0.003	0.9
LIBERTY DAM	(D)	1.5	0.2	0.8	0.0	0.1	0.0	0.0	0.6	1.3	0.8	0.3	1.1	0.000	0.000	0.40	0.011	0.000	3.3
NARAGUTA	(ST)	3.9	0.1	1.7	0.0	0.4	0.0	0.0	0.6	1.4	1.0	0.5	3.8	0.007	0.005	0.61	0.065	0.002	4.6
TIN MINING 1	(P)	7.0	0.2	0.6	0.0	0.1	0.0	0.0	0.5	0.6	0.8	0.2	0.9	0.005	0.003	0.16	0.016	0.000	2.9
TIN MINING 2	(P)	1.3	0.2	0.4	0.0	0.0	0.0	0.0	0.3	0.7	0.9	0.3	0.9	0.010	0.014	0.26	0.039	0.000	3.5
Mean		2.3	0.2	1.5	0.0	3.0	0.0	0.0	0.7	1.4	0.8	0.3	2.8	0.008	0.003	0.27	0.026	0.001	3.1

Note; Figures are average of 2-5 tests.
W-well
R-river
D-Dam
ST-stream
P-pond

Table 3.7. Comparative trace and heavy metal contents in treated and untreated waters in Jos and its surburbs.

LOCATION	Sn (PPB)	Mg (PPM)	Ca (PPM)	Pb (PPB)	Mn (PPB)	Cu (PPB)	Na (PPM)	K (PPM)	Zn (PPM)	Fe (PPB)	Cd (PPB)
1. Gangare Well (W)	206.	1.0	3.0	5.4	8.6	15.9	11.0	5.5	0.0	162.7	0.2
2. Gangare Jos Well (W)	138.6	2.0	14.0	7.0	3.2	7.0	16.0	7.0	0.0	255.8	0.4
3. Aze Gangare Well (W)	160.9	2.0	8.0	5.3	14.8	21.4	16.8	14.4	0.0	262.1	0.3
4. Zaria Road Tap (T)	195.9	0.5	7.0	4.7	3.0	3.1	2.2	1.8	0.1	104.7	0.5
5. Warden Barrack(Blk) Well (W)	147.6	0.0	1.3	3.4	5708.4	26.0	1.2	1.3	0.0	17,769.6	0.4
6. Warden Barrack(Blk)Tap (T)	141.3	28.0	228.0	5.5	6.4	19.6	42.0	9.8	0.7	332.5	2.6
7. St.Loius College Jos-Tap. (T)	129.2	0.3	1.0	7.8	6.7	6.8	1.3	1.3	5.6	7,152.0	0.5
8. Gada Biu Tap (T)	132.1	0.5	2.0	5.3	10.6	8.9	1.1	1.2	0.3	335.3	0.5
9. St.Loius College Jos-Tap (T)	140.6	0.2	0.8	7.8	780.0	41.5	10.5	1.5	0.3	42.0	0.5
10. Gada Biu Well (W)	120.1	2.0	12.0	8.6	16.6	31.5	30.0	6.3	0.0	0.0	0.3
11. Mr.Ali Stream (S)	130.5	1.5	2.5	7.1	41.0	43.3	9.0	1.0	0.0	3892.0	0.3
12. Mr.Alli Well (W)	139.7	0.3	3.0	7.1	15.4	35.1	2.8	0.8	0.0	316.0	0.4

W - Well S - STREAM

Table 3-2

LOCATION	Sn (PPB)	Mg (PPM	Ca (PPM)	Pb (PPB)	Mn (PPB)	Cu (PPB)	Na (PPM)	K (PPM)	Zn (PPM)	Fe (PPB)	Cd (PPB)
13.Katako Well Water (W)	215.8	1.5	1.6	5.9	16.8	238.2	24.5	3.0	0.0	638.0	0.8
14.Katako Street Tap (T)	173.8	1.5	14.0	11.1	7.8	18.7	1.2	1.3	0.0	201.0	0.5
15.JZ 54 Apat. Tap (T)	133.9	0.5	2.0	5.9	5.5	23.3	1.0	1.1	0.7	94.0	0.6
16.JZ 28 Apata Well (W)	136.8	1.0	3.5	7.6	148.0	42.6	23.0	7.2	0.7	169.9	0.5
17.Lake Chad	160.2	5.5	7.5	10.1	780.0	19.6	6.5	3.0	0.0	7,192.0	0.6
18.Pan Well (W)	179.4	5.0	6.5	6.2	54 .0	70.4	12.0	2.5	0.0	702.0	0.7
19.Pan Dam (D)	140.9	5.0	6.0	5.2	1248 .0	0.0	9.5	2.7	0.5	3684.4	0.6
20.Pan Un (D)	158.1	1.5	7.5	7.2	36 .4	10.4	16.0	3.2	0.0	345.4	0.6
21.Treated Brevery (I)	198.0	1.5	6.0	6.6	21 .3	36.0	2.1	10.8	0.0	1028.0	0.7
22.Brewery Exhaust (I)	3613.0	0.2	0.8	8.2	218 .0	6.8	17.5	1.8	0.0	5420.0	0.7
23.Human Activity (I)	202.1	0.2	3.5	34.5	2.2	0.6	16.4	1.8	0.2	96.0	0.7
24.Bukuru Sn Mining (I)	277.6	1.0	3.5	9.2	2.4	8.2	1.8	2.0	0.0	61.0	0.5

Table 3.3

LOCATION	Sn (PPB)	Mg (PPM	Ca (PPM)	Pb (PPB)	Mn (PPB)	Cu (PPB)	Na (PPM)	K (PPM)	Zn (PPM)	Fe (PPB)	Cd (PPB)
25. Inside Water (Waste)	220.8	1.5	2.0	8.4	8.8	8.9	30.0	2.0	0.0	239.0	0.7
26. Treated Water	201.1	1.0	2.0	10.8	32.4	15.0	2.4	1.3	0.0	2040.0	0.6
27. Ind. Exhaust (I)	220.1	1.0	2.0	7.5	12.4	63.2	2.5	1.8	0.6	203.0	0.8
28. PAN SAMPLE	371.3	1.0	1.5	9.6	34.1	104.4	2.6	1.5	0.3	374.0	0.8
29. Drytex Exhaust (I)	144.0	1.5	10.8	349	212.0	179.9	3.9	10.5	0.2	607.0	0.7
30. Coca Cola Exhaust (I)	186.5	3.0	102.0	475	84.0	53.3	3.8	42.9	0.3	16280.0	0.8
31. Combined Brewery - Treated + Exhaust (I)	306.9	0.2	32.0	35.8	31.0	83.9	3.5	2.5	0.2	3200.0	1.3
32. Bukure #2 Mining (I)	220.1	6.5	32.0	576	1488.0	173.0	18.5	7.0	0.8	1160.0	0.8
33. Coca Cola Mixt. Exa. (I)	292.4	3.9	1.0	218	760.0	-54.0	6.0	22.0	0.2	18040.0	0.7
34. Coca Cola Exhaust (I)	253.7	1.0	1.9	177	12.2	30.0	3.5	1.5	0.1	12744.0	0.7

Table 4. Organic and inorganic composition of water samples collected from Jos Metropolis.

LOCATION	pH	Na PPM	K PPM	As PPb	Cd PPb	Pb PPb	Mn PPb	Mg PPM	Ca PPM	Zn PPM	Sn PPM	Cu PPb	Fe PPM	SiO_2 PPM	TOC PPM	F^- PPM	Cl^- PPM	NO_3^- PPM	$SO_4^=$ PPM	$PO_4^=$ PPM	$CaCO_3$ PPM
1. NARAGUTA STREAM.	6.8	5.6	1.7	ND	ND	1.5	0.7	0.7	2.9	0.01	0.025	ND	0.19	18.4	0.24	0.14	1.9	0.4	1.4	0.6	—
2. TUDUN WADA WELL (STATE SECRETARIAT)	6.0	5.9	2.9	ND	0.2	ND	0.9	0.36	6.2	0.02	0.04	ND	0.04	6.7	0.09	0.23	1.2	1.2	1.2	ND	154
3. TIN MINING NO 1 POND	6.5	2.4	0.28	ND	ND	ND	1.4	0.2	1.1	0.002	0.01	ND	0.03	3.8	0.102	0.23	0.6	0.2	0.2	ND	3.0
4. " " NO 2 "	6.6	2.2	0.28	ND	ND	ND	0.4	0.3	1.3	0.004	0.005	ND	0.03	4.8	0.153	0.27	0.4	1.3	0.3	ND	5.0
5. JOS TAP WATER.	8.6	3.0	1.56	ND	0.2	ND	0.3	0.3	10.0	0.161	0.05	ND	0.06	8.3	0.049	0.2	0.9	1.5	22.3	ND	28.4
6. LIBERTY DAM.	6.6	2.4	1.32	ND	0.3	ND	0.9	0.4	1.6	0.007	0.025	ND	0.16	8.3	0.270	0.16	0.4	0.16	0.2	ND	7.6
7. LAMINGO DAM.	6.4	3.0	1.32	ND	ND	3	ND	0.3	1.7	ND	0.025	2	0.18	11.1	0.200	0.13	0.4	0.16	6.1	ND	5.0
8. RAIN WATER (FROM ROOF) JOS.		1.8	0.28	ND	0.2	ND	4.3	0.2	2.0	3.2	0.05	3.0	0.36	1.2	0.29						

PROJECTIONS: Eventhough the AAS and ICA are installed in the Biochemistry Department, there was an initial understanding that other Departments including Chemical Pathology, Zoology and Geology would send representatives to study and master the use of these equipments. So far, the goal of training representatives has not been attained because the various Departments have not availed themselves of this opportunity. It is envisaged that this training will be continued till the end of May 1985 when the Japanese expert (Mr. Noda), attached to the project, will be leaving for home. Training in the maintenance and repair procedures on these equipments are to be intensified, especially to the Biochemistry Department Nigerian counterpart who may take full responsibility for these equipments after the Japanese expert leaves.

Goitre studies will be extended to include analysis on foods and soils along with the water analysis which we have been surveying in the "goitre villages". This extended studies may allow us to make the correct associations between cations, anions and the incidence of goitre - which cationic or anionic deficiencies potentiate goitre.

The impact of human activity on drinking water will be studied using variables that include ammonia, nitrate, nitrite and phosphate detection. The effects of disinfection of drinking water and the correlation between the lack of disinfection with diarrhoea and dysentry will be investigated. Comparative studies will be continued between treated purified and untreated waters.

Studies on the heavy metal content of vegetables, crops harvested in Jos tin mining and industrial effluents will be continued. The concentration patterns for these metals starting from the soil, water, crops, vegetables and animals will be established. Our results so far show that for nearby all the elements studies, the elemental concentrations are as much as 100 fold higher in the crops than in the waste effluents. This work will be pursued further to establish the extent of elemental concentration in mammals.

We anticipate to start manitoring the organic constituents of health significance in water and foods. Our interest would involve the determinations of the concentration of benzene, chlorinated alkanes and alkenes, chlorophenols,

polynuclear aromatic hydrocarbons, triholomethanes and pesticides in our waters and foods. Most of these organic species are presursors to carcinogens or are carcinogens themselves and should be detected and controlled even when they occur in low levels in our environment. For this phase of the research we request that JICA supply us with 1) a gas chromatograph (GC) - the type that is sensitive enough to meet our needs. 2) A mini electrophoretic equipment to be used in monitoring any changes in protein pattern and concentration in mammalian sera as a result of the presence of those organic toxins in the human system. 3) Reagents for the determination of dissolved oxygen in water and industrial wastes. 4) Reagents for the determination of turbidity, colour, soluble silicates (SiO_2) and ammonia.

PRELIMINARY REPORT ON THE DISTRIBUTION OF TRACE ELEMENTS IN SOME SURFACE WATERS STREAM SEDIMENTS AND TISSUE DIGESTS OF AQUATIC BIOTA IN WATERS OF JOS PLATEAU.

By

EJIKE, C., D. I. ANADU & J. I. CHIDOBEM

INTRODUCTION

Effective abatement of aquatic trace elements pollution depends not only on treatment and control of waste waters but largely on the efficient monitoring of the general aquatic environment. Monitoring inland freshwater ecosystems involve two basic approaches.

i. Direct measurement of the spatial and temporal concentration of the trace-element or of important biologically active substances such as oxygen which are depleted by pollution

ii. The use of biological indicators which range from micro-organisms, macroinvertebrates and fish and physiological indices such as Biological Oxygen Demand (BOD) measurements to total community indicators such as changes in community structure.

The latter is widely employed in monitoring aquatic pollution. It includes such indices as the general species indicator index, community structure index, oxygen production (P) and utilisation (R) index and the consequent P/R ratios.

Defining the maximum permissible level of trace element in aquatic systems is of fundamental importance in monitoring trace-element distribution. High concentrations of heavy metals are probably responsible at times for reducing faunastic diversity in aquatic system. Often a mixture of trace-elements are present in varying levels in a freshwater body simultaneously and it is then extremely difficult to estimate the contribution of individual or component trace-elements.

Extensive methodologies have been developed for evaluating the effects of discrete trace elements toxicants on various aquatic organisms. Many of these have been amplified by concern over the environmental implication of bioconcentration of these trace elements. Hazards to aquatic biota as well as to human health caused by local contamination of the aquatic environment have been reported on by various workers.

METHODS

Analysis of trace-elements and pretreatment of sediments and Macroinvertebrates were carried out after the methods of Thomas and Chamberlin (1974). Digestion of water was done as recommended in APHA (1974). Trace elements levels in water, substrate and tissue digests were then monitored by the Atomic absorption spectophotometry. The study design allowed for sampling of streams, mine lakes and reservoirs. For the first two, selection was made from mining and non-mining zones and as far as possible from upland and lowland waters (See first JICA report).

Special attention was paid to the following elements Si, P, Mn, Fe, Cu, Zn, As, Se, Cd and Pb, While animal tissue digests of aquatic insects, decapod crustaceans, gastropod molluscs and fishes were investigated.

Because rainy season values are complicated by changing dilution factors greater reliance is placed on dry season values which apart from being more stable are likely to impact more on the life of the aquatic forms because of their higher levels of concentration.

Below is a tabulated form of the animal groups collected at the different stations in the dry season of 1984. Most of the sampled rivers and lakes drain into the Southern rivers which finally are drained into the Atlantic. The Delimi and a few other rivers North of Jos town drain into Shari river which is finally drained into the Lake Chad.

Table 1: Dominant animal groups during the dry season in some Jos Plateau Waters.

Sampling date	Site description and Name	Rocktype	Drainage type	Common Aquatic Animals	Bottom type
29/1/84	Pandam Lake		Into R/Benue through Dep river	Freshwater cray fish (large number) (Requires full identification) Ephemeroptera larvae Corixidae, the dragon fly larvae Anisoptera. Coleoptera, Hemiptera Diff. Fish species including Alestes, Labeo, Citharinus etc.	
29/1/84	Shandam IMpoundment	Sandstones and shales		Cray Fish (requires full identification Hemichromis, Water snails of the gastropod type	
29/1/84	Shandam bypass Stream with weirs & bridge at Jing		Into River Benue	Odonata (diff. types) Water beetles Coleoptera Blompharia	Sand stones
12/2/84	Kuru BaBa River		Possibly R/Benue	Tillapia zilli Garra waterloti Water Scorpion Dragon Fly, Damsel Fly larvae, Coleoptera, Corixidae	Gravels
12/2/84 8	Asob at Gangere Kibo		River Benue	Garra waterloti Aphyosemion sp Corixidae Dragon Fly larvae, Hemiptera Ephemeroptera nymphs.	Boulder & gravels

Table 1 Cont'd.

Sampling date	Site description and Name	Rock type	Drainage type	Common Aquatic Animals	Bottom type
12/2/84	Riom river	Weathered basalt	R.Benue	Garra waterloti Aphyosemion sp Hemiptera (stick-insects) Dragon Fly larvae Coleoptera, Crab.	Sandy
12/2/84	Asob on Jos-Akwanga Rd		R.Benue	Cray Fish (Large numbers) Dragon Fly larvae Garra wateroti Emphemeroptera Coleoptera Damselfly larvae, Trichoptera	Boulder
12/2/84	Barmo Cement Kaduna/Plateau		R.Benue	Garra sp Enough fish for population studies & electrofishing collection Hemiptera, Ephemeroptera Dragon fly larvae	Sandy
8/3/84	Miango Bukuru Goro river	Granite & sand	R.Benue	Odonata, Damselfly larvae, Hemiptera, Water stridders & skaters Garra sp	Boulder & brown colour
8/3/84	Miango reservoir			Damselflies, Ephemeroptera, Fish-Lates niloticus	
8/3/84	River Delimi at Tilindin Fulani	Migmatite	L.Chad	Chara Garra wateroti Berillius sp. Ephemeroptera Dragon Fly larvae Damselfly larvae Chironomid larvae Biomphalaria (snails).	Sand & Boulder
12/3/84	Stream supplying Lafia Fish pond on Pankshin Rd		Benue River	Crayfish Astacus? Lots Catfish probably of Ephemeroptera Dragonfly larvae.	

Results resume

2. Trace elements levels

The results so far indicate that some of the surface waters especially those located in mining zones and therefore likely to receive some form of effluents from mine wastes, contain more than the recommended levels of trace elements. The following elements have been identified as presenting posaible hazards.

Table 2. Observed range in Jos Plateau Waters (1) PPb; (2) ppm

1	Cd	(1)	0.2 - 2.5
2	Zn	(1)	7.0 - 2,000.
3	Cu	(1)	3.0 - 700
4	Pb	(1)	1 - 45
5	Mn	(1)	7 - 20,000
6	Se	(1)	T - 40
7	Fe	(2)	0.05 - 3.0

The data for sediments and tissue digests will be presented in a future report.

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COMPARATIVE SAMPLE DECOMPOSITION TECHNIQUES FOR THE ANALYSIS OF SIMPLE SULPHIDE MINERALS

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Abstract

Although a number of analytical techniques exist for the analysis of the metal content of sulphide minerals, one of the most favoured methods is by atomic absorption spectrophotometry (AAS). This is due to its precision, accuracy and convenience. The various sample decomposition techniques described in the literature for the analysis of sulphide minerals using atomic absorption spectrophotometry include the use of single acids of various strengths, such as nitric acid; a mixture of two strong acids, such as aqua regia; and a combination of more than two acids, such as hydrofluoric/perchloric/nitric and hydrochloric acids.

In this investigation, seven standard and modified standard procedures were used in the analysis of ten sulphide minerals from different parts of Nigeria with a view to finding out the relative advantages of the methods in terms of time, convenience, cost, accuracy and precision as a basis for a larger geochemical and environmental programme involving sulphides and other minerals associated with mining and mineral processing. The effects of the digestion techniques on the liberation and subsequent determination of eleven elements - Au, Ag, Cd, Ni, Cr, Co, Mn, Cu, Fe, Zn and Pb - were investigated. The results show that most of the elements could be efficiently, cheaply and conveniently leached using simple acids, such as 50 percent nitric acid, which is one of the simplest of the leaching techniques.

Introduction

In view of the importance of geochemical analysis in geology, several geochemical techniques have been developed for the elemental analysis of geochemical samples (Stanton, 1976; Westwood & Cooper, 1973).

These include gravimetric and titrimetric (classical) methods of analysis, molecular fluorimetry, radiometric and radioactivation methods, mass spectrometry and spark-source spectrography, x-ray emission spectrometry, flame emission and atomic absorption spectrophotometry.

Since geochemical prospecting techniques are critically dependant on precise and reasonably accurate analytical methods that are rapid enough to permit thousands of analyses to be carried out in a short time, most analysts have resorted to the use of the atomic absorption spectrophotometry. This is due largely to its precision, accuracy, convenience and the relatively less operator skill required in the use of the instrument (Reeves and Brooks, 1978).

Most substances requiring geochemical analysis are complex and consist of several elements or compounds. Quite frequently, these materials fall short of the ideal in terms of solubility, volatility, stability or homogeneity, and s all determinations in which the atomic absorption spectrophotometer (AAS) is used require that the element to be determined be in solution, several sample decomposition techniques prior to analysis have appeared in the literature (e.g. Stanton, 1976). The methods described usually differ depending on the nature of the sample and elements to be analysed.

Reeves and Brooks (1978) recommended the use of hot or cold hydrochloric acid (HCl), for the decomposition of most carbonates; solutions of nitric acids (HNO_3), for attacking ores of metals, like cobalt, copper, manganese, nickel and lead; and boiling concentrated HNO_3 for leaching sulphides of elements, such as lead and zinc from a silicate matrix. They also suggested the use of a mixture of HCl and HNO_3 (aqua regia) for facilitating the decomposition of carbonates, and the dissolution of sulphides using aqua regia or making the nitric acid medium more oxidizing through the addition of bromine.

In the decomposition of sulphide minerals, Rubeska (1968) specifically suggested the addition of mercuric nitrate solution to a mixture of nitric , sulphuric and tartaric acids in order to analyse for silver, zinc, cadmium-copper and lead in sphalerite, chalcopyrite, pyrite and galena. Donaldson (1982), in her "Methods for the Analysis of Ores and Related Materials," suggested the use of HNO_3, HCl, $HClO_4$ and HF in the analysis of sulphide minerals for copper, nickel, zinc, colbalt, cadmium and iron. Other analysts (e.g. Jeffery and Hutchison, 1981) recommended the use of fusion methods in the analysis of alkali metals, carbonates, hydroxides, peroxides, nitrates and borates. In this study, some of the above methods were employed in the analysis of some common sulphide minerals collected from several locations and mines, largely in sedimentary rocks in the Benue Trough of Nigeria, with a view to finding out precisely if the very simple methods yield data comparable with the most complicated ones in the analysis of lead, copper, iron, nickel, cobalt, manganese, zinc, gold, silver, chromium and cadmium using the same sample solutions. Such a study would contribute to reducing the risks involved in geochemical analysis using mixtures of several concentrated acids and encourage more analysts to study real geochemical samples. The use of the simple acids might also be faster, cheaper and easier for use by geoscientists with little formal training in analytical chemistry. This report, which is part of a major geochemical and environmental programme, discusses scientific, technical, economic and geochemical significance of the data.

Sampling

All the samples used were obtained from staff of the Department of Geology and Mining, University of Jos, and from the members of the public requesting for free advice on mineral resources of Nigeria. Therefore, no rigorous sampling procedure was undertaken in the classification and collection of the samples. Several samples are composed of mixed sulphides with gangue minerals, such as quartz, carbonates and sulphates.

All samples were crushed to very fine sizes, usually 100 mesh, using porcelain mortars. Details of the samples and their localities are given in Table 1.

Analytical Methods

The major equipment used in the determination was a manually oporated Perkin-Elmer Atomic Absorption Spectrophotometer, Model 2380, with a digital readout. In addition, some equipment of the Nigerian Mining Corporation was used. Samples were weighed into 500cm^3 conical flasks or teflon beakers and the required acids added. The mixtures were covered and heated on electric heating blocks or sand bath in a fume cupboard.

All reagents used were analytical grade reagents, unless otherwise stated. Solutions for standard calibration were obtained from the American Bureau of Standards and standard mineral samples were also analysed and used as standards.

Table 1: Details of Sulphide Samples Used

Sample Number	Sample Description	Sample Locality
A1	Altered sphalerite with minor galena	New Zurak Mine, Plateau State.
B2	Less altered sphalerite	New Zurak Mine, Plateau State.
C3	Galena	Ishiagu, near Abakaliki, Anambra State.
D4	Sphalerite	New Zurak Mine, Plateau State.
E5	Sphalerite	Ishiagu, near Abakaliki, Anambra State.
F6	Mine Dump Powder (White)	New Zurak, Plateau State.
G7	Galena	Azara, Near Lafia (probably)
H8	Sphalerite	Abakaliki, Anambra State.
I9	Chalcopyrite	"
J10	Arsenopyrite	Probably from Rishi, Bauchi State.

All glassware and plastic containers were washed using Acid washing liquid containing one percent nitric acid solution.

About 0.2g of each mineral sample was accurately weighed into a 500cm^3 clean, dry, conical flask and decomposed according to the methods briefly described below. Blank solutions were also prepared during each procedure and digestions were carried out in fume cupboards.

Method 1: 50 percent HCl/Conc HNO_3 (Reeves and Brooks, 1978) Modified

To 0.2g of each sample weighed into a conical flask, was added 10cm^3 of 50 percent hydrochloric acid. The mixture was heated on a hot plate for about 30 minutes. This boiling was to ensure that sulphur escaped as hydrogen sulphide to avoid precipitation of lead as sulphate. This was followed by the addition of 20cm^3 of concentrated nitric acid. After cooling, the mixture was boiled until the quantity of acid left in the conical flask was reduced to about 2cm^3.

The conical flask was then brought down, the sides washed with 25cm^3 distilled water and the contents of the flask returned to the hot plate and heated to boiling. The digest/solution was left to cool, transferred to a 100cm^3 volumetric flask and diluted to volume. Appropriate dilutions of these stock solutions were made where necessary prior to the determination of the elements concerned.

Method 2: 50 percent HCl/50 percent HNO_3 (Reeves and Brooks, 1978)

In this modified method of Reeves and Brooks (1978), the procedure followed was exactly the same as in the above method except that both acids were of 50 percent dilution.

Method 3: Aqua Regia (3:1 $HCl:HNO_3$) (Stanton, 1966)

The aqua regia used was prepared just before use. 30cm^3 of the mixture was used for the digestion of each 0.2g of sample. The rest of the procedure was as described in Method 1 above.

Method 4: Concentrated Nitric Acid (Reeves and Brooks, 1978)

In this method, 30cm^3 of concentrated nitric acid was used on each 0.2g of sample digested.

Method 5: 50 percent Nitric Acid (Stanton, 1966)

In this modified method after Stanton (1966), 30cm^3 of 50 percent HCl was used on each 0.2g of sample digested.

Method 6: Tartaric Acid/Nitric Acid/Mercuric Nitrate (Rubeska, 1968)

In this method, 10cm^3 of 10 percent tartaric acid was added to 0.2g of each sample in a conical flask followed by the addition of 6cm^3 of concentrated HNO_3. The mixture was left to stand at room temperature overnight. The following day, the mixture was heated on a steam bath for one hour, cooled and 3cm^3 of mercuric nitrate containing 10mg Hg/ml was added. The mixture was returned to the steam bath and heated until the sulphur turned white. The content of the flask was filtered and the undissolved residue and sulphur thoroughly washed with distilled water, collected into a 100cm^3 volumetric flask, and made up to volume.

Method 7: Concentrated HCl/HNO_3/$HClO_4$/HF Mixture (Donaldson, 1982)

0.2g of powdered sample was transferred into a teflon beaker and 10cm^3 of HCl added. The beaker was covered and boiled for several minutes. The beaker was removed from the hot plate and 10cm^3 of concentrated HNO_3 was added and the mixture boiled until most of the sulphide minerals were decomposed. Then 10cm^3 of perchloric acid and 5cm^3 of hydrofluoric acid were added. The solution was boiled for several minutes after which the cover was removed and the solution evaporated to white fumes of perchloric acid. The solution was cooled, the sides of the beaker washed down with distilled water and the solution evaporated to a moist paste. To the moist paste, 3cm^3 of concentrated nitric acid and 25cm^3 of water were added and the mixture heated to dissolve the soluble salts. Some high quality dry paper pulp was added to the solution, where necessary, using Whatman No. 40 filter paper, the solution was filtered into a 100cm^3 volumetric flask. The paper and residue were washed properly and the solution made up to volume.

Results and Discussions

The results of this study are as presented in Tables 2 to 12. In general, the results show that iron, copper, nickel, chromium,

cobalt, manganese, cadium and zinc were easily leached out using any of the acid digestion techniques. The most complicated methods, such as those utilising HCl, HNO_3, $HClO_4$ and HF in one digestion mixture did not always produce the highest and most consistent results.

In the analysis for lead, it was observed that lead sulphate easily precipitated out of solution, giving the erratic results shown in Table 10. However, a repeat of the analysis with a smaller sample weight 0.1g rather than 0.2g proved very suitable as seen in Table 12. Table 12 also shows that all the seven digestion methods gave comparative results which are in agreement with earlier suggestions by several analysts. The results on Table 3 show that Methods 1, 2, 4, 5 and 7 gave silver contents very close to those of Method 6. Method 6, suggested by Rubeska (1967), describes a particular modification for the analysis of silver. In general, low results were obtained in the analysis for silver using aqua regia (Method No. 3). This is because this acid mixture proceeds as follows:

$$3HCl + HNO_3 \rightleftharpoons 3H_2O + NOCl + Cl_2$$

Nascent chlorine is expected to attack precious metals and some sulphides taking most metals into solution either as their simple chlorides or as complex chloro-anions. However, as silver chloride is not very soluble, this may have contributed to the low values obtained for silver using the aqua regia method of sample attack.

It was generally observed that there is the need for a little quantity of the acid to remain in the digestion flask at the end of the digestion. In cases where the acids were allowed to completely dry up, lower results were obtained, particularly for lead. The precipitates formed were insoluble in water, probably because of oxidation. It was also observed that the sphalerite samples were digested very easily using any of the methods, and as would be expected, they did not create the problem of producing insoluble precipitates even if the solutions dried up. Therefore, the published general analytical descriptions or methods for sulphides are not of general applicability since some sulphides create less digestion problems than others. As noted from above, lead sulphides probably give most problems.

For example, the starting quantity in the analysis for lead in galena should not be the same as the starting quantity for the analysis of zinc in zinc sulphide-sphalerite. For sphalerite, the major, minor and trace elements can easily be determined in the same sample solution, but for lead, which requires a smaller amount of sample to be digested, an analyst may run the risk of not being able to detect the trace elements if analysis for lead must be done on the same sample solution as precipitates of lead salts may co-precipitate other trace elements.

Another important factor which needs mentioning here is that the digestion flask should be covered during sample digestion to avoid the mixture drying up even before the sample is completely digested. Since drying up of samples would lead to the addition of more acids to the digested samples, this would raise the possibility of contamination and the amounts of elements present in the blanks.

In all the samples analysed, gold could not be detected probably because of the low contents of gold in the samples. To assay for gold, higher sample weights would have been digested for this specific purpose, in view of the generally lower gold contents in these types of sulphides. Although detailed geochemical and genetic discussions will be carried out elsewhere, the data presented in the tables show that the Zurak and Lafia(?) area sulphides contain the highest amounts of silver, and that, in general, the trace element contents reflect the environment from which the samples were obtained.

Conclusion from the Results

It can be concluded that 50 percent nitric acid is a convenient, simple and cheaper method for the digestion of simple sulphide minerals prior to the determination of lead, iron, copper, zinc, manganese, chromium, silver, nickel, cobalt and cadmium, using atomic absorption spectrophotometry. The use of concentrated acids or a mixture of concentrated acids in addition to the possible hazards

and high cost involved, does not always produce exceptionally different results from those obtained using 50 percent nitric acid.

This study suggests that simple, easy to obtain and work with acids should be used for the digestion of sulphide samples rather than wait for the purchase of platinum crucibles or teflon beakers at exorbitant prices before sulphide samples can be decomposed for analysis with a mixture of hydrofluoric, hydrochloric, perchloric and nitric acids as suggested by Donaldson (1982). In this era of recession and high cost of imported materials, such laboratories can conveniently carry out digestions using beakers or conical flasks with concentrated nitric acid, or better, cheaper and safer still, with 50 percent nitric acid.

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Table 2: Iron Content (Weight Percent) in some Nigerian Sulphides

DIGESTION METHODS

Samples	1	2	3	4	5	6	7	
	50% HCl/ Conc HNO_3	50% HCl/ 50% HNO_3	Aqua Regia	Conc. HNO_3	50% HNO_3	Tartaric/ Nitric/ Mercuric Nitrate	$HCl/HNO_3/HClO_4$ HF	Sample Locality and Type
A	2.00	2.00	2.00	2.00	2.00	2.00	1.80	Zurak sphalerite (altered)
B	2.00	2.00	2.00	1.80	2.60	2.00	2.20	"
C	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	Ishiagu galena
D	8.60	8.60	9.40	9.40	8.60	9.60	9.00	Zurak sphalerite
E	1.001	1.00	1.00	1.00	1.00	1.00	1.00	Ishiagu sphalerite
F	1.40	1.40	1.40	1.40	1.40	1.20	1.40	Zurak white mine dump powder
G	3.80	3.80	3.80	3.60	3.60	3.20	2.60	Lafia-Azara galena
H	4.80	4.60	4.40	4.80	4.80	4.80	4.40	Abakaliki sphalerite
I	35.40	35.80	36.40	36.80	36.20	33.00	31.60	"
J	27.00	26.80	26.80	26.80	20.60	14.00	27.40	Rishi-Bauchi arsenopyrite

n.d. = not detected.

Table 3: Silver Content (in parts per million) in some Nigerian Sulphides

DIGESTION METHODS

Samples	1 50% HCl/ Conc HNO_3	2 50% HCl + 50% HNO_3	3 Aqua Regia	4 Conc. HNO_3	5 50% HNO_3	6 Tarteric/ Nitric/ Mercuric Nitrate	7 HCl/HNO_3/ $HClO_4$/ HF	Sample Locality and Type
A	836	758	26	1117	930	1172	883	Zurak sphalerite
B	125	94	31	172	156	164	172	"
C	172	172	156	227	219	211	294	Ishiagu galena
D	94	109	47	148	102	109	94	Zurak sphalerite
E	258	273	16	289	281	273	297	Ishiagu sphalerite
F	438	484	94	461	469	453	547	Zurak white mine dump powder
G	1430	1461	55	1461	1445	1781	1875	Lafia-Azara galena
H	31	36	8	31	36	39	31	Abakaliki sphalerite
I	195	211	94	188	195	211	211	Abakaliki chalcopyrit
J	102	102	86	94	94	109	102	Rishi Bauchi arsenopyrite(?)

Table 4: Copper Content (ppm) in some Nigerian Sulphide Samples

DIGESTION METHODS

Samples	1 50% HCl/ Conc HNO_3	2 50% HCl + 50% HNO_3	3 Aqua Regia	4 Conc. HNO_3	5 50% HNO_3	6 Tart-aric/ Nitric/ Perc. Nitrate	7 HCl/ HNO_3/ $HClO_4$/ HF	Sample Locality and Type
A	556	536	571	571	554	554	607	Zurak sphalerite
B	1429	1429	1429	1464	1429	929	1500	"
C	36	36	36	36	37	36	37	Ishiagu (Abakaliki) galena
D	714	730	730	732	714	732	732	Zurak sphalerite
E	643	536	661	607	625	661	571	Ishiagu (Abakaliki) sphalerite
F	536	571	571	571	579	554	554	Zurak white mine dump powder
G	79057	78929	78929	78929	79857	80357	78571(?)	Lafia-Azara galena
H	571	589	607	607	607	625	643	Abakaliki sphalerite
I	245536	251706	251786	248214	250000	2393	2527	Abakaliki chalcopyrite
J	212	214	214	179	196	214	196	Rishi-Gauchi arsenopyrite(?)

Table 5: Nickel Contents (ppm) in some Nigerian Sulphides

DIGESTION METHODS

Samples	1	2	3	4	5	6	7	
	50% HCl/ Conc HNO_3	50% HCl/ 50% HNO_3	Aqua Regia	Conc. HNO_3	50% HNO_3	Tartaric/ Nitric/ Mercuric Nitrate	HCl/HNO_3/ HCl/HF	Sample Locality and Type
A	45	45	30	30	30	20	30	Zurak sphalerite (altered)
B	45	40	35	35	40	15	15	"
C	20	20	n.d.	20	20	20	20	Ishiagu (Abakaliki) galena
D	20	20	20	20	20	20	20	Zurak sphalerite
E	15	15	15	15	15	15	10	Ishiagu (Abakaliki) sphalerite
F	50	50	50	55	65	50	50	Zurak sphalerite
G	n.d.	n.d.	n.d.	20	20	n.d.	n.d.	Lafia-Azara galena
H	25	20	n.d.	25	25	n.d.	n.d.	Abakaliki sphalerite
I	210	275	22	260	255	210	220	Abakaliki chalcopyrite
J	55	55	n.d.	40	50	n.d.	20	Rishi-Bauchi arsenopyrite(?)

n.d. = not detected.

Table 6: Chromium Content (ppm)

DIGESTION METHODS

Samples	1 50% HCl/ Conc HNO_3	2 50% HCl/ 50% HNO_3	3 Aqua Regia	4 Conc. HNO_3	5 50% HNO_3	6 Tartaric/ Nitric/ Perchlo Nitrate	7 $HCl/HNO_3/$ $HClO_4/HF$	Sample Locality and Type
A	30	30	15	35	35	35	40	Zurak sphalerite (altered)
B	30	30	10	25	30	30	30	"
C	35	35	5	30	30	30	35	Ishiagu (Abakaliki) galena
D	20	20	20	20	20	20	20	Zurak sphalerite
E	25	25	5	15	20	20	20	Ishiagu (Abakaliki) sphalerite
F	30	30	5	20	20	25	28	Zurak white mine dump powder
G	10	10	n.d.	10	10	10	5	Lafia-Azara galena
H	5	5	n.d.	5	5	5	5	Abakaliki sphalerite
I	10	10	n.d.	n.d.	5	10	10	Abakaliki chalcopyrite
J	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	Richi-Bauchi arsenopyrite

n.d. = not detected.

Table 7: Cobalt Content (ppm) in some Nigerian Sulphide Samples

DIGESTION METHODS

Samples	1 50% HCl/ Conc HNO_3	2 50% HCl/ 50% HNO_3	3 Aqua Regia	4 Conc. HNO_3	5 50% HNO_3	6 Tartaric/ Nitric/ Mercuric Nitrate	7 HCl/HNO_3/ $HClO_4$/HF	Sample Locality and Type
A	335	335	335	335	335	335	335	Zurak sphalerite (altered)
B	775	775	775	775	775	775	775	"
C	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	Ishiagu (Abakaliki) galena
D	835	835	835	835	835	775	775	Zurak sphalerite
E	335	335	335	335	335	335	335	Ishiagu (Abakaliki) sphalerite
F	335	335	335	335	335	335	335	Zurak white mine dump powder
G	110	110	110	110	110	110	110	Lafia-Azara galena
H	500	500	445	500	500	390	400	Abakaliki sphalerite
I	335	335	335	335	335	335	335	Abakaliki chalcopyrite
J	665	665	720	665	665	555	665	Rishi-Gauchi arsenopyrite

n.d. = not detected.

Table 6: Manganese Content (ppm) in some Nigerian Sulphide Samples

DIGESTION METHODS

Samples	1 50% HCl Conc HNO_3	2 50% HCl 50% HNO_3	3 Aqua Regia	4 Conc. HNO_3	5 50% HNO_3	6 Perteric/ Nitric/ Mercuric Nitrate	7 $HCl/HNO_3/HClO_4/HF$	Sample Locality and Type
A	555	575	555	600	605	600	520	Zurak sphalerite (altered)
B	130	130	130	130	125	135	130	"
C	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	Ishiagu (Abakaliki) galena
D	2760	2775	2760	2840	2755	2900	2770	Zurak sphalerite
E	5	5	5	5	5	5	5	Ishiagu (Abakaliki) sphalerite
F	745	740	745	750	760	760	610	Zurak white mine dump powder
G	40	40	35	35	35	35	35	Lafia-Azara galena
H	840	849	845	805	800	820	835	Abakaliki sphalerite
I	13750	14000	13500	13730	13500	13750	14250	Abakaliki chalcopyrite
J	25	25	20	30	25	20	25	Richi Bauchi arsenopyrite

n.d. = not detected.

Table 9: Cadmium Content (ppm) in some Nigerian Sulphide Samples

DIGESTION METHODS

Samples	1 50% HCl Con HNO_3	2 50% HCl 50% HNO_3	3 Aqua Regia	4 Conc. HNO_3	5 50% HNO_3	6 Tartaric/ Nitric/ Perchloric Mixture	7 $HCl/HNO_3/HClO_4/HF$	Sample Locality and Type
A	607	634	598	569	643	616	536	Zurak sphalerite (altered)
B	2197	2197	2232	2268	2278	2116	2045	"
C	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	Ishiegu (Abakaliki) galena
D	1366	1348	1331	1322	1340	1241	1215	Zurak sphalerite
E	1697	1652	1625	1643	1652	1661	1590	Ishiegu (Abakaliki)
F	696	674	679	679	696	706	652	Zurak white mine dump powder
G	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	Lafia-Azara galena
H	2241	2241	2206	2232	2295	2259	2277	Abakaliki sphalerite
I	90	90	80	80	80	n.d.	18	Abakaliki chalcopyrite
J	27	27	27	27	27	27	27	Nishi-Gauchi arsenopyrite

n.d. = not detected.

Table 10: Lead Content (weight percent) in some Nigerian Sulphides

DIGESTION METHODS

Samples	1 50% HCl Conc HNO_3	2 50% HCl 50% HNO_3	3 Aqua Regia	4 Conc. HNO_3	5 50% HNO_3	6 Perchloric/ Nitric, Hydrofluoric Mixture	7 $HCl:HNO_3$/ $HClO_4$/Air	Sample Locality and Type
A	21.00	44.72	16.00	33.80	17.42	39.54	38.74	Zurak: sphalerite (altered)
B	0.03	0.03	0.03	0.03	0.03	0.03	0.03	"
C	44.72	56.60	25.22	30.40	47.32	44.04	72.30	Ishiagu (Abakaliki) galena
D	0.03	0.02	0.01	0.03	0.03	0.03	0.03	Zurak sphalerite
E	0.03	0.03	0.02	0.03	0.03	0.03	0.03	Ishiagu (Abakaliki) sphalerite
F	7.67	7.81	7.80	7.50	7.15	7.12	7.07	Zurak white mine dump powder
G	62.40	67.34	15.11	63.20	45.34	44.52	69.80	Lafia-Azara galena
H	1.47	1.47	1.45	1.47	1.54	1.55	1.51	Abakaliki sphalerite
I	1.00	1.01	1.21	1.00	1.03	1.02	1.00	Abakaliki chalcopyrite
J	0.04	0.04	0.04	0.05	0.04	0.04	0.04	Richi-Daushi arsenopyrite(?

Table 11: Zinc Content (weight percent) in some Nigerian Sulphide Samples

DIGESTION METHODS

Samples	1 50% HCl Conc HNO_3	2 50% HCl 50% HNO_3	3 Aqua Regia	4 Conc. HNO_3	5 50% HNO_3	6 Perchloric/ Nitric/ Mercuric Nitrate	7 HCl/HNO_3/ $HClO_4$/HF	Sample Locality and Type
A	26.00	26.00	26.05	27.00	27.80	27.70	26.05	Zurak sphalerite (altered)
B	52.20	52.10	52.13	52.24	52.20	52.23	52.21	"
C	0.01	0.01	0.01	0.01	0.01	0.01	0.01	Ishiagu (Abakaliki) galena
D	49.73	49.73	49.70	49.73	49.73	49.73	48.05	Zurak sphalerite
E	62.72	62.72	62.71	62.70	62.74	62.73	62.60	Ishiagu (Abakaliki) sphalerite
F	30.69	30.69	30.32	30.69	30.50	30.50	30.04	Zurak white mine dump powder
G	0.11	0.11	0.11	0.12	0.11	0.11	0.12	Lafia-Azara galena
H	61.03	61.70	61.70	62.98	62.01	61.98	61.70	Abakaliki sphalerite
I	0.09	0.05	0.05	0.05	0.05	0.05	0.05	Abakaliki chalcopyrite
J	0.004	0.004	0.004	0.004	0.004	0.004	0.004	Biebi-Doughi arsenopyrite(?)

Table 12: Lead Content (weight percent) in some Nigerian Sulphide Samples using Smaller (0.1 gm) Sample Weights for Digestion

DIGESTION METHODS

Samples	1 50% HCl Conc HNO_3	2 50% HCl 50% HNO_3	3 Aqua Regia	4 Conc. HNO_3	5 50% HNO_3	6 Tartaric/ Nitric/ Perchloric Nitrate	7 HCl/HNO_3/ $HClO_4$/HF	Sample Locality and Type
A	38.90	38.90	38.90	36.10	37.50	35.50	38.70	Zurak sphalerite (altered)
C	83.30	83.30	83.30	77.80	77.80	76.40	76.30	Ichiagu (Abakaliki) galena
F	8.30	8.30	7.90	7.90	7.90	7.60	8.80	Zurak white mine dump powder
G	68.30	68.00	68.00	69.00	68.70	68.30	69.60	Lafia-Azara galena

ENVIRONMENTAL AND ECONOMIC STUDIES OF TRACE ELEMENTS ASSOCIATED WITH MINING AND MINERAL PROCESSING IN PARTS OF PLATEAU STATE, NIGERIA – A PRELIMINARY REPORT*

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ABSTRACT

The Plateau State of Nigeria has a surface area of about 58000 km^2 and elevation above mean sea level ranges from about 200 to 1800 metres. A number of major tributary river systems which flow to the Rivers Niger and Benue and to Lake Chad rise from the Plateau. The State is covered by igneous, metamorphic and sedimentary rocks of Precambrian to Recent age within which, under favourable geological conditions, are several mineral occurrences and economic deposits. Economic deposits of cassiterite, columbite-tantalite, lead-zinc, thorite, zircon, barytes, salt, clays, mineral water, limestone, coal, iron ore, marble and gemstones are known in the State. A number of these have been mined, processed and smelted on large- or small-scale basis.

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A large number of samples of rocks, minerals, stream sediments, soils and laterites, mine dumps, slags, water and plant materials have been carefully collected from areas of known mineral occurrences and mineral processing plants and also from apparently 'barren' areas and analysed for major, minor and trace elements. This forms the basis for students' training and systematic baseline trace element data used for a multidisciplinary study in mineral exploration, fundamental studies of crustal evolution and ore-forming processes, and environmental studies, including those in agriculture, medical geography, pollution studies and ecological fields of interests since major metal pollution originates from geological weathering, industrial processing of ores and metals, the use of metals, leaching of metals from domestic and solid waste dumps, and animal and human excretions.

Preliminary results from this on-going study show that although mining and mineral processing have contributed a lot to the national economy and the growth of a number of towns in Plateau State, it has also contributed immensely to environmental pollution. However, with careful monitoring and mineral exploitation using modern techniques of large- and small-scale mining and mineral processing, the mining industry in Plateau State could continue to provide jobs, save and earn foreign exchange and supply major alloy metals

(such as tin, tantalum, niobium, molybdenum, tungsten and titanium) and probably by-product metals (such as silver, antimony, cobalt, germanium, cadmium, copper, uranium, thorium, hafnium and zirconium). However, under the current practice without strict environmental protection laws and enforcement, major environmental and health hazards for the State and other parts of Nigeria which are drained by rivers flowing from the high plateau might result.

1 INTRODUCTION

Metals make up the largest group of the chemical elements, but their characteristics differ greatly within the biosphere. It is now widely recognised that the important factor determining the effects of a metal on organisms is not generally its total concentration but rather its speciation - the specific forms and nature of the element . Metals may occur as hydrated ions, as complex inorganic or organic ligands, as adsorbed and absorbed ions, as colloids, as precipitates, and in live and dead biota. Some metals may also be essential to human life, whereby as trace elements they are always present in certain proportions in all healthy living tissues of the same species and deficiency symptoms may be noted with their depletion or removal which can be attributed to distinct

biochemical defects. Examples include potassium, sodium, magnesium and calcium. When the supply of some essential trace elements, such as zinc, becomes excessive, they become toxic. Toxic levels are generally 40-to 200-fold of the minimum levels required for correct nutritional activity in the organism. Hence, in the studies of trace elements from the possible sources to man, the general trend followed is that an undersupply leads to element deficiency, sufficient supply results in optimum conditions, and oversupply results in toxic effects and, possibly, death in the end.

The essential metals, whose ions are used by biological systems must of necessity be both relatively abundant in nature and readily available as soluble species. However, when considered from environmental pollution point of view, metals may be classified (i) as non-critical, such as Na, K, Mg, and Ca, which are essential metals and hard acceptors of electrons (Lewis acids) and which form stable bonds with hard donors (Lewis bases), such as H_2O, OH^-, Cl^-, etc; (ii) toxic, but very soluble or very rare; and (iii) very toxic and relatively accessible metals. The two last groups are generally soft acceptors which form stable bonds with soft donors, such as -SH groups and other active sites of proteins. Some common elements which, at toxic levels,

become major health hazards are As, Be, Cd, Cr, Cu, Pb, Hg, Mo, Se, Ag, Th, and Zn. In some cases, unusual concentrations have produced intoxicating or catastrophic effects, as in the cases of mercury poisoning in Minamata Bay, Japan; Cadmium poisoning causing the "itai itai" disease in the Japanese villages on the banks of the Jintsu River, Toyama, Japan; lead poisoning, as in Leipzig, Germany, during the summer of 1930, etc. (Forstner and Wittmann, 1983). A large number of such studies have been documented from Japan, Europe and U.S.A., but similar studies are yet to be published on Nigeria.

In a number of developed countries, variable but enforcable national standards that determine the quality of water for different uses have been set. Although no such enforcable standards or environmental protection laws currently exist in Nigeria, the quality of Nigeria's surface and underground waters can be compared with these international standards so as to establish concentration levels below which harmful effects may be produced. Toxic metals may occur in aqueous ionic forms derived from minerals and from man-made sources, such as herbicides, fertilisers, detergents, metal processing and industrial processing and products. Permissible limits for waters must take cognisance of the accumulation by organisms through the food chain and

the environmental impact of waters discharged to the environment, especially for domestic, recreational, agricultural and industrial purposes. Drinking water quality criteria have been proposed by the World Health Organisation (WHO) and several developed countries. These limits show wide fluctuations which often vary by up to a factor of 200.

In general, there are five different major sources from which metal pollution of the environment originates. These are geological weathering of rocks, industrial processing of ores and metals, the widespread use of metals and metal components, leaching of metals from domestic refuse and solid waste dumps, and animal and human excretions, which generally contain heavy metals. Plateau State has several mineral occurrences, most representatives of Nigerian igneous, metamorphic and sedimentary rock types, and has a long history of mining, mineral processing and smelting. Hence, the resultant extensive environmental and human pollution through geological and human activities provides a key area for the environmental and economic geological study of trace element mobility from baseline or background sources in rocks and minerals through geological, human and biological activities to man via the food chain.

In areas characterised by metal-bearing rocks, these trace elements will necessarily occur at much higher levels

than the baseline or natural background levels in the water, soil, plants and bottom sediments of the area. Areas with economic deposits are exploited to recover and process the ore. This in turn leads to the disposal of tailings, discharge of effluents to specially constructed lakes or natural drainage systems, discharge of effluents and possibly processing and smelting operations. These processes result in atmospheric and hydrological pollution. The general problem which, therefore, arises is how to distinguish between natural geological weathering and metal enrichment attributable to human and industrial activities.

This study is, therefore, aimed at determining the trace element contents in rocks, stream sediments, minerals, soils, plant and water samples from the tin and lead-zinc mining and non-mining areas of Plateau State with a view to establishing their negative and positive environmental effects and economic significance (Ogezi, 1984). Another aim is that since critical pollution, geochemical and mineral exploration studies are often hampered by cumbersome, costly and often dangerous analytical techniques, simple, cheap and reasonably accurate and precise methods of analyses will be devised and developed to facilitate the large number of analyses involved (Adiuku-Brown and Ogezi, 1984 and this volume). Another important aspect of the study is

scientific students' training for the acquisition of new knowledge and skills and updating of ideas, especially in the fields of environmental geochemistry and mineral exploration (Adiuku-Brown, 1983; Agada, 1983; Bob-Manuel, 1983; Ekpo, 1984; Hamza, 1984; Ochonogor, 1984; Okeke, 1984; Onyeji, 1984). It is also hoped that in collaboration with the metal mining, processing and fabrication organisations, through the investigation of mineral processing of tin and its associated by-products and lead and zinc, cheap methods of extraction will be found for such metals as niobium and tantalum from tin and associated ores, and silver, cobalt, lead, zinc, etc. from lead-zinc ores. This would provide suitable indigenous alloying metals for virile Nigerian metal-based industries as well as save and earn foreign exchange, provide jobs and aid in the acquisition of technical skills.

2. SAMPLING AND SAMPLE PREPARATION

In view of their significance, it was decided to use samples of rocks, minerals, waters, stream sediments, mine dumps, ores, slags, soils, laterites and plant material for this study. Based on a detailed knowledge of the geology of the State, the possible sampling sites covering the high and low altitude areas of Plateau State were selected to include areas with different rock types, different types of water bodies, mineral occurrences, economic mineral deposits, mines, mineral processing and apparently barren areas. These areas cover the whole State. Based on this, about 10 areas and about 22 sampling localities were selected for coverage. In spite of this pre-sampling decision based on regional geology, a detailed geological reconnaissance was carried out at each sampling locality to deduce the local geology, evidence of mineral exploitation, topography, vegetation, drainage and other features of the area. Samples were labelled in the field and details recorded in field notebooks and on geological and topographic maps. A summary of the type and approximate number of samples collected is presented in Table 1.

At each point where a water sample was taken, air and water temperatures, conductivity, pH, Eh, turbidity and the colour of the water was recorded prior to a minimum

Table 1: Summary of Types and Localities of Samples Collected for Preliminary Regional Study and Numbers treated so far.

S/No.	Sample Types	Approximate Total No. Collected	Approximate No. Partially Collected
1	Rocks	200	40 - for mineralogy, major and trace elements
2	Stream sediments	100	25 - for mineralogy, trace elements and sizes
3	Soils and laterites	50	10 - for size fractions
4	Minerals	20	15 - for mineralogy, major and trace elements
5	Mine dumps	10	5 - for mineralogy
6	Smelting slags	5	-
7	Stream and lake waters	120	50 - for Ca, Mg, Cu, Fe, Zn, Mn and Pb
8	Plants	20	-
9	Well waters	20	15 - for pH, T and trace elements

of 250-500 ml of water being taken into clean, carefully rinsed-out plastic water bottles which were previously washed with dilute nitric acid.

Water samples were preserved in a refrigerator and analysed shortly after collection. To minimise the effects of organic substances, bring all the ions to the same form or oxidation state in solution and minimise metal absorption onto the walls of containers, all water samples were acidified with analytical reagent grade nitric acid to a pH of about 2. The possibility of sample contamination by substances leached from the container walls and absorption of constituents onto container walls were considered and tested for, but negligible. Standardised strict water sample collection, preparation and analytical procedures as well as the use of blanks and standard determinations are being devised for the detailed stage of this investigation. Similar procedures and basic equipment for pore waters in sediments and for plant materials are being collated.

For rock samples, fresh large samples weighing a minimum of 2 kg are collected, and representative fresh portions sawn for thin section preparation or crushed into powder for analysis. Sulphide minerals and stream sediments were leached using hot dilute nitric acid or acid mixtures as described in Adiuku-Brown and Ogezi (1984, and this volume).

For the major and trace element analysis of rocks and laterites carried out at the Technical University of Berlin,

the lithium tetraborate fusion technique was used. To do this, 0.3000 ± 0.0002 g finely ground (-120 mesh) material was weighed and completely homogenised for at least 10 minutes in an agate mortar with 1.2000 ± 0.0002 g lithium tetraborate. After complete homogenisation, 1.2500 g of the mixture was weighed into a 6 cm^3 graphite crucible and put in the furnace set at 1000°C for 30 minutes for fusion to be complete. The molten mixture was quickly and completely transferred into a beaker, on a hot plate, containing 30 ml of 4 per cent nitric acid (made from 10 ml HNO_3 and 165 ml distilled water) and the mixture stirred until completely dissolved. The solution was quickly filtered, the filter paper thoroughly washed and the filtrate made up to 50 ml, thereby giving a 200-fold dilution for the atomic absorption spectrophotometric determination of trace elements. For the determination of major elements, a 2000-fold dilution was used. Although the lithium tetraborate digestion technique is simple, effective and cheap when compared with other digestion techniques, the major problems are those of complete recovery of the molten mixture from the crucible and consistent analytical results.

PERFORMANCE AND RESULTS

So far, a review of and the acquisition of relevant literature and analytical techniques have been completed. However, in view of the limited sensitivity of the sample preparation and analytical facilities and materials available, progress has been necessarily slow. Preliminary analysis of over 50 water samples using the Departmental Manual Perkin-Elmer 2380 Atomic Absorption Spectrophotometer (AAS) has been completed for Ca, Mg, Cu, Fe, Zn, Mn, Pb and Cd (Tables 1 to 5). This has largely confirmed the necessity for preconcentration of samples prior to AAS analysis of samples or analysis using more sensitive equipment that can analyse concentrations at parts per billion (ppb) levels instead of parts per million (ppm) possible with the AAS.

Since the inception of the project, seven B.Sc. (Honours) theses projects have been completed (Agada, 1983; Ekpo, 1984; Hamza, 1984; Manuel, 1983; Ochonogor, 1984; Okeke, 1984; Onyeji, 1984) and one research (M.Phil/Ph.D.) project has been initiated (Adiuku-Brown, 1983). In addition, two conferences papers have been presented in which it was shown that sulphides could be leached using simple dilute acids and that mining activity poses major environmental hazards in the Zurak area (Adiuku-Brown and Ogezi, 1984 and this volume; Ogezi, 1984).

In a study of an area of about 28 km^2 of the area around Delimi River Basin, off the Jos-Bukuru Road from Narabi to Tilden Fulani in Bauchi State, Agada (1983) carried out a sedimentological analysis of the upper reaches of the Delimi, which flows several hundred kilometres to Lake Chad in the northeast. He showed that the sediments are poorly- to moderately-sorted down the river basin and composed of coarse- to medium-grained sands which were deposited in one phase of deposition. The moderate rounding was as a result of the corroding ability of the channel bedrock. The winning of economic deposits of cassiterite, sand and gravel and shallow groundwater from alluvial sediments recharged by the Delimi River, which drains Jos, could have major effects on water quality. Detrital minerals and minor radioactive element mineralisation in the sediments of parts of Bauchi and Bornu States, several hundred kilometres north-east of Jos, have been ascribed to the rocks of the Younger Granite Province (C. Okujeni, oral communication, 1983). Pollution could similarly extend downstream towards Lake Chad.

In a similar geological, mineralogical and geochemical study of the northeast part of Naraguta Sheet 168, covering the Permanent Site of the University of Jos, Ekpo (1984) showed that the major rocks of the area are the migmatites, gneisses and the Jurassic Younger Granites, together with

minor intrusions of basic dykes and aplo-pegmatitic gneisses. By studying the geochemistry and mineralogy of the rocks, stream sediments and water, it was shown that the finest-clay-size fractions had the highest concentration of iron, copper, manganese, cobalt, lead, calcium and zinc. Concentrations could be correlated with the mineralogy, the geology and environmental factors. Elements, such as lead, cobalt and copper, detected could be correlated with pollution from metropolitan Jos.

Hamza (1984), in a similar study of the area south of the Jos-Rukuba Road, in Plateau State, studied the geology, trace element content and mineralogy of stream sediments within the area to provide a basis for predicting the environmental hazards and mineralisations of the area. Although the raw water samples had relatively low trace element contents, Hamza (1984) showed that in the stream sediments, the coarsest-size fractions formed the bulk of the samples and that the relative proportions decreased with progressively finer fractions. This may be due to sampling, or more likely, due to nearness of stream sediments to source rocks. After hot extraction with 4M HNO_3, it was found that, with very few exceptions, the finest or clay-size fractions of stream sediments had the highest contents of Fe, Cu, Mn, Pb, Ca, Mg and Zn (Table 2).

This was attributed largely to adsorption to clay fractions, but individual variations along the same streams of trace element concentrations was correlated with rock type and environmental factors, such as mining, mineral processing and human activities (Table 2).

Table 2: Trace Element Contents (ppm) of Different Stream sediment near Jos after Hot Extraction with 4M HNO_3 (after Hamza, 1984, Table 3 p. 47, and Table 7.1, p. 58). The highest concentrations are in the finest size fractions. Note lower concentration in water samples.

Sample No.	Mesh Size of Stream Sidiments	Trace Elements (ppm)							
		Fe	Cu	Mn	Co	Pb	Ca	Mg	Zn
STS-1	+0.5mm	200	0.5	3.0	0.3	0.5	0.0	1.8	1.1
	-0.5+0.25mm	275.7	0.3	3.8	0.3	0.6	0.1	1.8	1.6
	-0.25+0.125mm	298.6	1.4	5.8	0.4	1.0	0.3	66.3	2.2
	-0.125mm	586.5	16.9	14.0	0.7	2.0	0.8	12.4	12.5
	Water	4.0	n.d	1.0	n.d	n.d	3.5	2.7	0.3
STS-2	+0.5mm	119.0	0.6	1.0	0.4	0.5	1.1	0.4	70.0
	-0.5+0.25mm	118.9	0.0	1.0	0.4	0.8	1.0	0.3	45.0
	-0.25+0.125mm	167.6	0.6	1.0	0.4	0.8	1.9	0.5	90.0
	-0.125mm	275.7	3.9	3.0	0.6	3.6	2.1	0.6	5.0
	Water	4.0	n.d	n.d	n.d	n.d	3.5	2.7	n.d
STS-3	+0.5mm	127	1.3	1.6	0.1	0.6	0.1	2.8	1.1
	-0.5+0.25mm	137.8	0.3	1.8	0.1	0.9	0.1	1.8	0.9
	-0.25+0.125mm	210.8	0.7	2.8	0.3	2.0	0.2	2.8	1.4
	-0.125mm	437.8	7.1	8.0	0.5	2.5	0.4	9.8	4.0
	Water	3.3	n.d	n.d	n.d	n.d	3.3	2.7	n.d

n.d. = not detected.

Manuel (1983), in a stratigraphic and sedimentological study of the tin mineralisation in parts of the Gold and Base Company Mines in the Rayfield-Barakin Delimi areas, Jos, showed that the sediments are poorly sorted, angular to sub-angular, medium- to coarse-grained river sands deposited in an oxidizing environment in stream channels averaging 6 metres each in depth and width. Manuel (1983) also showed, from stratigraphic correlations and heavy mineral analysis, that the highest concentration of cassiterite and associated ores occurred at sediment depths ranging from 4 to 8 metres, due largely to their higher density. Detailed sedimentological analysis showed that the sediments were mainly saltated by the river currents and the poorly-sorted angular nature was due to the action of eddy currents on these materials deposited close to source areas.

Ochonogor (1984), in a geological and environmental geochemical study of the Rayfield-Bukuru area, where there was extensive past alluvial mining and mineral processing, showed that the concentration of most trace elements in the waters were within permissible international standards. Although a much larger sample population was required for firmer conclusions, Ochonogor (1984) tentatively ascribed the variations in elemental concentrations to environmental, human and geological factors, and recommended detailed multi-

disciplinary study, especially since endemic goitre and other diseases, which occur in the general area, may be due to geochemical factors. Ochonogor also obtained trends of trace element concentrations in stream sediments similar to those of Ekpo (1984) and Hamza (1984), whereby trace elements generally increased with decrease in grain sizes of sediments (Table 3). Well water samples contained significantly lower Ca, Mg, Fe, Zn and Mn than adjacent stream waters, hence well waters would provide purer drinking waters (Table 3). However, in the absence of thick weathered superfical cover wells dry up during the dry season

Table 3: Trace Element Contents of Stream Sediments (S), Stream Waters (SW), and Well Waters (WW) from the Rayfield-Bukuru area, near Jos (after Ochonogor, 1984, Table 3, p. 45, and Table 4, p. 47). Compare data with Table 2.

Sample	Stream Sediment Mesh Size (MM)	Trace Elements (ppm)							
		Fe	Cu	Mn	Co	Pb	Ca	Mg	Zn
S1	+0.5mm	62.2	0.0	1.1	0.1	0.0	0.3	0.4	0.3
	-0.5+0.25mm	180.1	0.1	2.2	0.1	0.0	0.6	1.2	0.7
	-0.25 - 0.125mm	173.0	0.1	3.2	0.2	0.0	0.6	1.8	1.1
	-0.125mm	200.0	1.4	8.0	0.2	0.3	32.0	7.0	5.0
S2	+0.5mm	91.9	0.1	0.6	0.1	0.0	0.1	0.3	0.4
	-0.5 + 0.25mm	127.0	0.5	1.0	0.1	0.1	0.1	0.6	0.9
	-0.25+0.125mm	105.4	0.5	1.8	0.2	0.2	0.4	1.2	1.4
	-0.125mm	78.4	2.8	3.1	0.4	0.5	0.8	2.0	3.0
S3	+0.5mm	59.5	0.0	0.6	0.2	0.0	0.1	0.3	0.5
	-0.5 + 0.25mm	75.7	0.1	0.9	0.2	0.1	0.1	0.7	0.6
	-0.25+0.125mm	87.8	0.1	1.2	0.4	0.0	0.3	0.9	1.2
	-0.125mm	229.7	4.5	4.3	0.8	0.0	1.6	3.1	7.7
SW1	Stream Water	9.7	n.m	0.2	n.m	n.m	2.5	0.1	0.0
SW2	" "	8.7	n.m	0.3	n.m	n.m	16.0	2.7	0.0
SW3	" "	9.0	n.m	0.4	n.m	n.m	11.8	1.8	0.1
SW4	" "	9.7	n.m	0.2	n.m	n.m	2.4	0.1	0.0
WW1	Well Water	0.0	n.m	0.0	n.m	n.m	0.0	0.0	0.0
WW2	" "	0.0	n.m	0.0	n.m	n.m	0.0	0.0	0.0

n.m = not measured.

Okeke (1984), in a geological and hydrogeological study of the northern part of Naraguta Sheet 168 NE, between the Jos-Bukuru and the Rukuba Younger Granite Complexes of the Jos area, identified three hydrogeological units consisting of the Quaternary sedimentary deposits, the weathered zones in the crystalline igneous and metamorphic rocks, and the tectonically fractured zones in the crystalline rocks. The thickness of each unit varies and water levels fluctuates widely, resulting in several dry wells at the peak of the dry season, about April/May. Okeke correlated the chemical quality of the groundwater in the study area with the geology. When compared with World Health Organisation (WHO) standards for drinking water, both the surface and groundwater of the area have total hardness, pH, cations and anions, etc., within permissible limits. However, the colour and turbidity of the Delimi River and some wells, as well as their ammonia, taste and amount of total dissolved solids are largely, from preliminary examinations, excessive. These waters need treatment prior to domestic and industrial uses as they have been polluted by agricultural practice, the extensive use, especially along stream valleys of animal and manufactured fertilisers, disposal of solid and animal waste into and along the banks of the Delimi River and its tributaries

(such as near Gada Bauchi and Gada Biyu), leachates from the extensive past mining activities in the Naraguta area, and poor sanitation from cemetries, septic tanks and liquid waste from open gutters draining Jos, especially as storm run-off. In areas of relatively thin superficial cover, or excessive concentration of water wells, where over-abstraction of water occurs, the water wells, which supply purer water than the stream water, most wells become dry during the dry season. A complete assessment of the quality of the surface and subsurface waters must include bacteriological studies.

Mineralogical examination of the Bisichi-Jantar mine dumps shows that the dump contains zircon, monazite, thorite, and opaque ore minerals, such as magnetite with ilmenite in oriented intergrowth, magnetite martitised,or replaced by limonite or replaced by rutile, pseudorutile or leucoxene. The oxidation and leaching is caused by the presence of water. Columbite-tantalite, and rare chromite and tapiolite are also present (A. Mücke, personal comm., 1984). Preliminary examination of these mine dumps and stream sediments indicate high radioactivity and mobile trace element contents.

In a geological study, with particular reference to the sedimentation pattern of the Delimi River valley north of Jos, especially in order to delineate the paramaters which determine the sedimentation of tin-bearing minerals, Onyeji (1984) indentified tectonic structures, such as joints, veins, dykes, folications and lineations in crystralline rocks, and graded bedding, cross bedding, massive bedding and mudcracks in stream-laid sedimentary rocks. The Delimi River is erosional and highly channelised when it passes through ridges. Grain size analysis shows largely unimodal distribution but with symmetrical and asymetrical distribution. Samples with asymmetrical distribution of grains contain large amounts of heavy minerals, including cassiterite, and these samples largely occur upstream of channel bars. Mineralogical and textural features of grains suggest that the sources of the sediments are very close by, largely from the surrounding Younger Granite and Basement Complex rocks.

Like the proportional distribution found by Hamza (1984), Onyeji's more ditailed sieving showed that although the greatest portion (over 80 percent) were the 2mm to 0.5mm fractions, there was also systematic decrease in the relative proportions from the 0.5 to 0.125mm mesh fractions. The major components of grains were 60-80 percent quartz, 10-30 per cent feldspars, 5-15 percent opaque oxides and up to 10 percent rock fragments for the light fractions, while the heavy minerals included monazite, zircon, magnetite, ilmenite and cassiterite.

Adiuku-Brown and Ogezi (1984 ; and this volume) analysed ten different sulphide minerals, consisting largely of galena, sphalerite and arsenopyrite, from different parts of Nigeria using acids, acid mixtures and different acid strengths and found that dilute nitric acid, which is one of the cheapest, safest and simplest of the leaching solutions used, gave results comparable to those using stronger and more dangerous acids or acid mixtures, or using the specific methods for sulphides. These sulphides could be correlated with their geological environments and could provide significant by - product elements, such as Cd, Sb, Cu, Ag from the sphalerite and galena, Sb from galena, and Ge and Cd from the sphalerite (Table 4). Elements which could also cause impurities and metallurgical problems are also discernible (Table 4). In view of the large number of samples that may be treated for a comprehensive study, as well as considerations of safety, procurement and technical problems, the use of simple dilute leachates is of vital importance, especially

Table 4: Major and Trace Element Contents of Samples from the New Zurak Lead-Zinc Mines, SW Plateau State, Nigeria.

Sample No.		Sample Type	Majors (wt.percent)			Trace Elements (ppm)								
			Fe	Zn	Pb	Cu	Sb	Ag	Cd	Ni	Cr	Co	Mn	Ce
1	A1	Altered Sphalerite	2.0	26.8	38.8	564	-	950	603	40	34	335	575	-
2	B2	Less altered Sphalerite	2.1	52.2	0.0	1447	-	158	2190	40	30	775	130	-
3	D4	Less altered Sphalerite	9.0	49.7	0.0	726	-	109	1340	20	20	820	2795	-
4	F6	White Mine Dump powder	1.4	30.5	8.0	562	-	475	683	52	25	335	750	-
5	7663	'S' Galena	-	0.1	65.0	200	900	1900	-	-	-	-	-	-
6	7665	'M' Galena	-	0.5	70.0	400	2200	500	-	-	-	-	-	-
7	7660	'S' Sphalerite	2.5	58.62	2.0	-	-	200	2300	-	-	-	-	-
8	7664	'M' Sphalerite	2.6	59.0	1.0	-	-	100	2000	-	-	-	-	-
9	7659	'P' Occurrence Galena	-	0.0	73.0	200	500	600	-	-	-	-	-	-
10	7651	'O' Occurrence Sphalerite	3.5	58.3	0.8	-	-	-	2600	-	-	-	-	-
11	7652	'O' Occurrence Galena	-	0.5	70.0	500	300	450	-	-	-	-	-	-

Notes: Serial Nos. 1-4 = Mean values of analyses from Adiuku-Crown and Ogezi(this vol.)
Serial Nos. 5-11 = From NECCO Consultancy Report for Nigerian Mining Corporation, Jos (1976) on Geological Investigations of Lead-Zinc mineralisation in the areas of Abakaliki and Zurak, Nigeria (p137 - p138)(p137-p138)

- = Not determined or measured
n.d. = Not detected.

in developing countries short of foreign exchange, technical personnel and equipment.

In an economic and environmental study of the lead-zinc mining area of Zurak, south-eastern Plateau State, (Ogezi, 1984; and in Prep) showed that apart from the major economic significance of the Zurak mine, which has been closedfor about 45 years since 1937, because of the metallurgical and infrastructural problems and depressed metal markets, the dumps are a major source of pollution to surface and underground water as well as plant and animal life in the area (Table 4).

The mineralogy of the sphalerite - and galena-rich sulphides from the Zurak Pb-Zn mine consists of galena (PbS), sphalerite (ZnS), marcasite and pyrite (FeS_2), and minor bravorite (Ni, Fe)S_2, chalcopyrite ($CuFeS_2$), bournonite ($CuPbSbS_3$) and bravoite boulangerite ($Pb_5\ Sb_4\ S_{11}$). White, highly corrosive mine dump powder is scattered over the mining area and has resulted from the partial decomposition of the sulphides to weathered sphalerite, galena, chalcopyrite, pyrrhotite, graphite and some sulphates. (A. Mücke, pers. comm., 1984). Some of these minerals are reported for the first time in Nigerian sulphide ores.

The Zurak mine pit water used for domestic purposes by the inhabitants of New Zurak is green in colour, has typical sulphide smell, and largely devoid of animal life and generally contains much higher concentrations of Ca, Mg, Zn, Fe and Cd than Jos tap water, streams and reservoir waters in the Jos area and the Zurak

area pond water not polluted by haman activity (Table 5). A multidisciplinary study of the area is planned to assess the total effects of mining and mineral processing on the small rural community of New Zurak Village and on plant and animal life in the area.

Apart from the investigations reported above, a preliminary investigation of the effects of human activity on the chemical quality of surface water has been carried out on samples of water from the Lamingo (Liberty) Dam and along a tributary stream to the Delimi from Lamingo Dam to the bridge on the Ring Road, near the Gospel Faith Church, Jarawa, Jos (Table 5). Apart from Mn, the dam water contains lower or similar amounts of Ca, Mg, Na, Zn and Fe. Stagnant waters with significant biological activity and areas along the streams defecated or used for laundary contained significantly higher Ca, Fe, and Na (Table 5). This type of study is being conducted throughout Jos area in streams and wells, but the necessity for integrated bacteriological studies cannot be overemphassised.

4. CONCLUSIONS AND RECOMMENDATIONS

The results of the preliminary stages of this research project reported above has, apart from providing invaluable students' training, brought out clearly a number of problems and suggested a number of lines that could be followed in the next stage of the research:

i) Standardised instructions covering sample collection, preparation, treatment, storage and analysis procedures

Table 5: Concentration in parts per million (ppm) of Trace Elements in Liberty Dam Reservoir and Upper Delimi Tributary Waters (LD) near Jos, Jos City Tap Water, Zurak Mine Pit Water and Sabon Gari Pond Water, from unmineralised area near Zurak.

Field Sample No.		Sample Type and Locality	Trace Elements (ppm)								
			Ca	Mg	Mn	Na	Zn	Fe	Pb	Cd	Cu
1	LD1	Eastern bank. Liberty Dam Reservoir	1.00	0.30	38.0	2.12	0.01	0.2	-	-	-
2	LD2	Small northern overflow west of Sherre Hills	0.91	0.28	41.6	1.79	0.01	0.1	-	-	-
3	LD3	Small southern overflow west of Sherre Hills	8.40	0.34	11.5	2.10	0.02	0.1	-	-	-
4	LD4	Stagnant confluence of LD2 and LD3	3.18	0.37	15.0	2.10	0.02	0.1	-	-	-
5	LD5	Stream "laundry" ca 50m	4.95	0.54	26.1	2.60	0.01	1.2	-	-	-
6	LD6		0.61	0.09	26.4	3.20	0.01	1.3	-	-	-
7	LD7	Small spring to stream from NW	1.59	0.35	2.7	5.10	0.03	2.0	-	-	-
8	LD8	Water west (downstream) of Ring Road bridge near Gospel Faith Church, Jarawa, Jos	1.46	0.32	1.2	5.03	0.02	2.1	-	-	-
9	J2A	Jos Tap Water, Unijos	n.d.	2	n.d.	-	n.d.	n.d.	n.d.	n.d.	n.d.
10	ZW1	Zurak Mine Pit Water, south pit	2	111	3	-	14	n.d.	3	1	n.d.
11	ZW2	" " , north pit	30	135	n.d.	-	98	n.d.	2	4	n.d.
12	ZW3	Sabon Gari, Zurak Pond Water	2	27	n.d.	-	n.d.	1	n.d.	n.d.	n.d.

- = not determined or measured
n.d. = not detected.

should be prepared, together with details of field determinations and observations, preferably in a card form.

ii) The forms of ions to be determined and their significance should be looked into rather than the total ions being determined as at present since the ions which move with water are those which are either soluble in water or those that occur as components of stable suspensions as cations and anions, uncharged atoms, organic complexes, as colloids and suspended matter, and as ions absbobed on suspended matter. Their toxicity and effects depend on their speciation or the forms and nature of the atoms.

iii) In view of the relatively low concentrations of most trace elements in the water samples analysed and of (ii) above, preconcentration of atoms by ion exchange, solvent extraction, etc., or the use of more sensitive methods and equipment should be considered. Seasonal variations should also be checked in all waters.

iv) With the acquisition of more basic equipment and reagents, more systematic sample colection, preparation, digestion and analysis would be embarked upon, especially for stream sediment, water and rock samples.

The following tentative scientific and environmental recommendations and conclusions could be reached from the results of these preliminary investigations:

v) Most of the alluvial stream sediment deposits are derived

from nearby sources and, often, contain minerals with high radioactivity, such as monazite, thorite and zircon. These minerals may have harmful effects when used for houses.

vi) Although some elements may be leached from mining, mineral processing and mine dumps, etc., their concentrations in sediments, waters, soils, plants and animals depend on their solubility and speciation as well as the season. Some lake water not suitable domestic and industrial uses could be investigated for recreational and agricultural purposes.

vii) Dilute nitric acid is adequate for the extraction of most major and trace elements from sulphides and stream sediments.

viii) The clay-size or finest fractions of stream sediments generally had the highest concentration of the environmentally significant trace elements, and most variations could be explained by geological and human factors.

ix) The well waters generally contained less trace elements and are more suitable for domestic and industrial purposes than stream waters, but seasonal variations are to be investigated in both waters. In general, their trace element contents reflect season, and geological and human factors. Bacteriological tests are necessary on the waters to deduce their optimum uses.

x) Some sulphide and other ore minerals contain significant amounts of by-product trace elements which could make their mining, processing and extraction more economic than as of now.

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The last report of JICA-UNIJOS Research Project on Endemic Goitre which covered the period for second half of 1983 had outlined the overall objectives of the study, the methodology employed for survey, classification of goitres phasing of the project, plan of action for 1984 etc.

The survey of endemic goitre among pre-adolescent children in schools of Bassa L.G.A. of Plateau State was carried out. The following work has been completed up to the 1st half of 1984, ending June 1984.

1. A total of 1104 school children in the Government Secoundary Schools of Binchi, Zagun, Jengre and Miango have been surveyed. (See enclosed map). The results of survey have been outlined in Tables 1 - 5 in Appendix A.
2. A total of 81 blood samples from the school children, both with and without thyroid enlargement, have been collected by the department of Chemical Pathology for Thyroid Function Tests. These samples have been frozen and stored for analysis at a later date.
3. The village leaders in Bassa L.G.A. (the Chief of Bassa and Heads of the villages) have been contacted to elicit their support and co-operation for the purpose of extending the goitre survey work to the general population in the area. The response have been most encouraging and support for the survey work for endemic goitre in villages has been promised.
4. A total of 19 drinking water samples from as many villages in the area has been collected for physico-chemical examination of water samples as well as determination of iodine (iodide ions by ion chromatography analyser) in the drinking water. Some samples have already been analysed and the results on the remaining are expected to be available soon.

Constraints in Carrying out the work:

According to the time schedule coutlined in the initial report of the project a total of 6000 students were expected to be covered up by the survey team by the end of June 1984 as part of phase I of the study. Due to non-availability of the vehicle for survey work from April '84 onwards no survey could be carried out during the last quarter and the target of coverage of 6000 school children has not been achieved. Meanwhile the

schools have closed down for long vacation till September 1984. The equipment and chemicals needed by Chemical Pathology Department for thyroid function tests have not yet arrived and work has not been possible to be started.

Plan of action during Second Half of 1984:-

On the basis of experience gained till date the study team feels that within the multiple pressures of work on the academic staff involved in the study it would not be possible to cover the entire Platear State under the survey work. This would be particularly so in view of the distances of different L.G.A. from Jos. The resource position for carrying out the study is also not expected to improve dramatically in near future. In view of the above, it is therefore necessary to modify the targets for achievement mentioned in earlier reports. The study team proposes the following changes -

(i) The original target of coverage of 6000 school children for survey will be reduced to about 3000.

(ii) A total of about 2000 school children yet to be covered up will be surveyed as soon as the schools open after long vacation.

(iii) However, the remaining children will be covered up in two L.G.A. other than Bassa, the selection being made on the basis of their topographical location and physical features. The department of Land Survey of Plateau State has been approached and they promised to make available necessary data to help select the L.G.A. for the study.

(iv) The community response for the survey of general population for endemic goitre has been very encouraging in Bassa L.G.A. This will be fully exploited to carry out the study of the prevalence of endemic goitre and the related clinical entities viz. cretinisms, hypothyvoidism etc. Blood samples for study of thyroid function test will also be collected.

(v) Water and soil samples from the area will be collected and subjected to iodine estimation. Thus a composite data on prevalence, clinical picture, thyroid function and iodine availability for at least one L.G.A. (Bassa) sill be collected by the end of 1984, thus devetailing phase I and phase II of the study.

Appendix - A

RESULTS OF ENDEMIC GOITRE SURVEY AMONG SCHOOL CHILDREN

The last report used the criteria given by Perezett al[1] for classification of degree of tyroid enlargment. This has been modified to the classification suggested by Demaeyeret al[2] in the W.H.O. recent report on The Control of Endemic Goitre. The two classifications are given below to provide a comparision.

Classification by DeMaeyer		Classification by Perez	
Grade	Description	Grade	Description
0	Thyroid not palpable or if palpable not larger than normal	0a	Normal thyroid gland
1a	Thyroid distinct by palpable and definitely larger than normal but usually not visible with the head in a normal or extended position	0b	Gland which though distincly enlarged and abnormal are not usually visible when the head is extended.
1b	Thyroid easily palpable and visible with the head in an extended position. The presence of a small nodule also qualifies the patient for inclusion in this grad	1	Enlarged gland on palpation; usually visible when head thrown back and neck fully extended.
2	Thyroid easily visible with tge head in a normal position.	2	Goitre visible with head in normal position, palpation not necessary to establish presence.
3	Goitre visible at a distance	3	Goitre grossly visible at a distance.
4.	Monstrous goitre		-

1. Perez, c. et al. Bull. of World Health Organisation, 18, 217, 1958

2. De Maeyer et al, The Control of Endemic Goitre, WHO, Geneva. 1979.

As can be seen the grade Ob and 1 have been changed to 1a and 1b respectively in DeMaeyers classification which is the criteria used in the following table.

Table 1. Prevalence of Different Grades of Goitre in school children.

Grade	No.	%
Normal Thyroid	887	80.3
1a Goitre	172	15.6
1b	37	3.4
Total	1,104	100

Table 2. Age-wise Prevalence of Endemic Goitre among School Children

Age (in Years)	No.Examined	with Goitre	%
Below 16	440	119	27.0
16 yrs & above	664	90	13.6
Total	1104	209	18.9

Table 3. Sex-wise Prevalence of Endemic Goitre in School Children

Sex	No.Examined	with Goitre	%
Male	727	80	11.0
Female	377	129	34.2

Note: All the 37 cases of grade 1b were in female students

Table 4. Prevalence of Endemic Goitre in Different Schools

School	No.Examined	With Goitre	%
Zagun	339	89	26.3
Binchi	103	20	19.4
Jengre	422	78	18.5
Miango	240	22	9.2
Total	1,104	209	18.9

Table 5. Source of Drinking Water and Prevalence of Endemic Goitre among School Children

Source of Water	No.EXamined	With Goitre	%
Well	572	133	23.3
Stream/Pond	473	67	14.2
Tap	59	9	15.3
	1,104	209	18.9

Observations;- From the data above the following observations are made;-

1. Of the 1104 school children examined 172 (15.6%) had endemic goitre grade 1a and 37(3.4%) had grade 1b. The overall prevalence was 18.9%. According to a WHO criterian a prevalence rate of 5% and above of enlargement of thyroid in pre-adolescent are goup children indicates that the area has endemic goitre problem. Applying that criterion Bassa LGA sums to be an endemic goitre area.

2. The prevalence of endemic goitre was twice as high in children and below 16 years (27.0%) than in children above 16 years (13.5%).

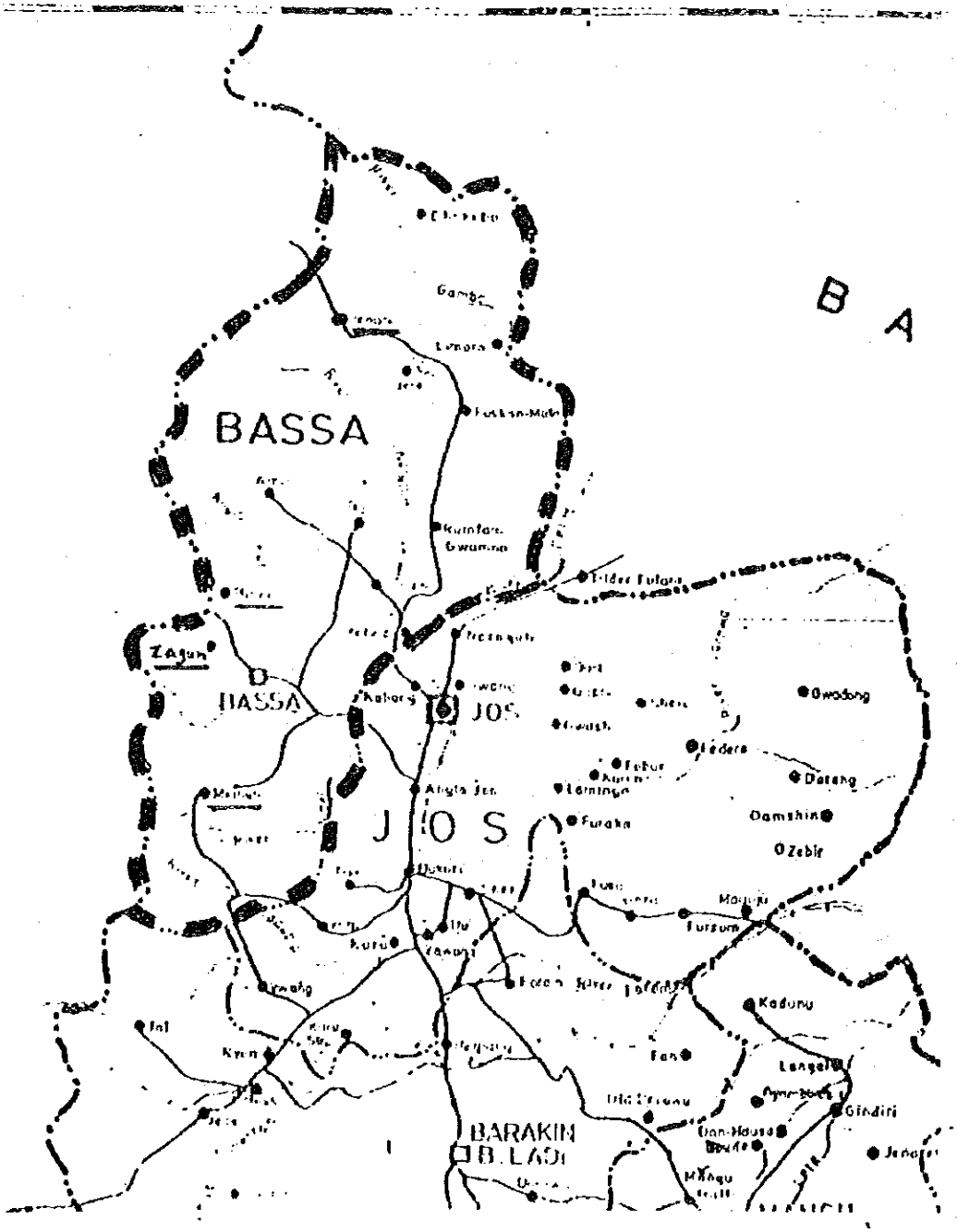
3. The prevalence of endemic goitre was thrice as high among females (34.4%) than in male children (11.0). Also all the 37 cases of grade 1b thyroid enlargemnt were among females.
Thus the difference is not only quantitative but in terms of size of enlargement.

4. Among the children of four different schools examined the highest prevalence was among Zagun students (26.2%) and lowest among Miango school children (9.1%). While at this stage of the study it is difficult to draw any valid conclusions, this difference could be due to geographical location andaltitude of the place. Zagun and Binchi which had higher prevalence rate had an altitute of between 3600-4000 feet a.s.l. as compared to Jengre and Miango which were relatively on a lower level (3000 a.s.l.) Also Binchi and Zagun are located on an undulated area while the other two are on a flat area comparatively.

5. Endemic goitre prevalence was 23.3% in children using well water as compared to 14.2% using water from stream and pond for drinking. Some children used more than one source of drinking water.

Acknowledgemnt:- We are thankful to His Highness Chief of Binci and Village Heads for their co-operation in our work. We express our thanks also to the Principals and teachers of G.S.S. at Binci, Zagun, Jengre and Miango for their help in survey work and Mr. Barko of Plateau State Survey Department for providing us the maps and reading the altitude data for us.

PLATEAU STATE
OVERNMENT COUNCIL AR



Report presented during National Symposium on Human Vaccines Development and Production in Nigeria, Jos, June, 1984.

DIARRHOEA IN CHILDREN - BACTERIOLOGICAL INVESTIGATION: A PRELIMINARY REPORT.

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"The acute diarrhoeal diseases have long been recongnized as a major cause of mortality and morbidity in young children in the developing countries... it can be estimated that there were some 744 million to billion episodes of diarrhoea, and 4.6 million deaths in children under five years of age in the developing countries / excluding China/ in 1980" - M.H.Merson, International Symposium on Bacterial Diarrhoeal Diseases, Osaka, Japan, March 1982/2/.

The presented report is a part of the ongoing multidisciplinary project on the clinical, aetiological and epidemiological studies of diarrhoeal diseases in children under five years in Plateau State. This project is carried out jointly by Departments of Medical Microbiology and Parasitology, Pediatrics and Community Health of the University of Jos in close co-operation with Japanese International Co-operation Agency, Tokyo Japan.

Specimens and Laboratory Procedures:

The specimens were collected from diarrhoeal children in Pediatrics Ward, OPD and Child Health Clinic of the University Teaching Hospital, and the Plateau State Hospital. Freshy voided of catheterized stool samples were placed in Carry and Blair transport medium and sent to the laboratory. In the laboratory, the routine techniques, i.e. plating on proper media and serological and biochemical tests were carried out, Table1 /1/.

Table 1.

Results:

Between October, 1983 and June, 1984, 362 stool samples were examined / Table 2 /

Table 2.

From 91 samples, i.e. 25 % of cases, pathogenic bacteria were isolated. The detected bacteria are present4ed in Table 3.

Table 3.

Among 96 isolates were: 30 strains of Shigella, 11 strains of Salmonella and 35 strains of Escherichia coli. These groups of bacteria are well known as causative agents of diarrhoea. The last group of 20 isolates comprises 5 bacterial genera, which can also be resp9nsible for this condition. According to WHO experts/2/ at least 25 various microbial agents can be incriminated as causative agents of diarrhoea.

Shigella strains were isolated from 30 specimens /Table 4/

Table 4.

Shigella flexneri, represented by 20 strains belonging to 9 various serotypes was in domination in comparison with S. dysenteriae and S.boydii, 5 and 3 isolates respectively.

There were 11 Salmonella isolated /Table 5/ belonging to B and E groups. Some strains were not serological classified.

Table 5.

Using 28 specific antisera, among 35 isolates of E. coli, 28 enteropathogenic, and 7 enterotoxigenic strains were identified, Table 6.

Table 6.

Interesting is, that we were unable to identify any enteroinvassive strain.

In the determination of dryg susceptibility, 8 drugs, which are active

against Gram-negative rods were used. It does not mean that all used drugs can be administered in the treatment of diarrhoeal cases. The obtained results are presented in Table 7.

Table 7.

In most cases, Shigella, Salmonella and Escherichia trains were resistant to sulphonamides, streptomycin, tetracycline and ampicillin, i.e. drugs which can be used in treatment of diarrhoea. On the hand, the isolates were susceptible to nitrofurantoin,colistin and nalidixic acid, i.e. drugs which are not used in the treatment of this condition.

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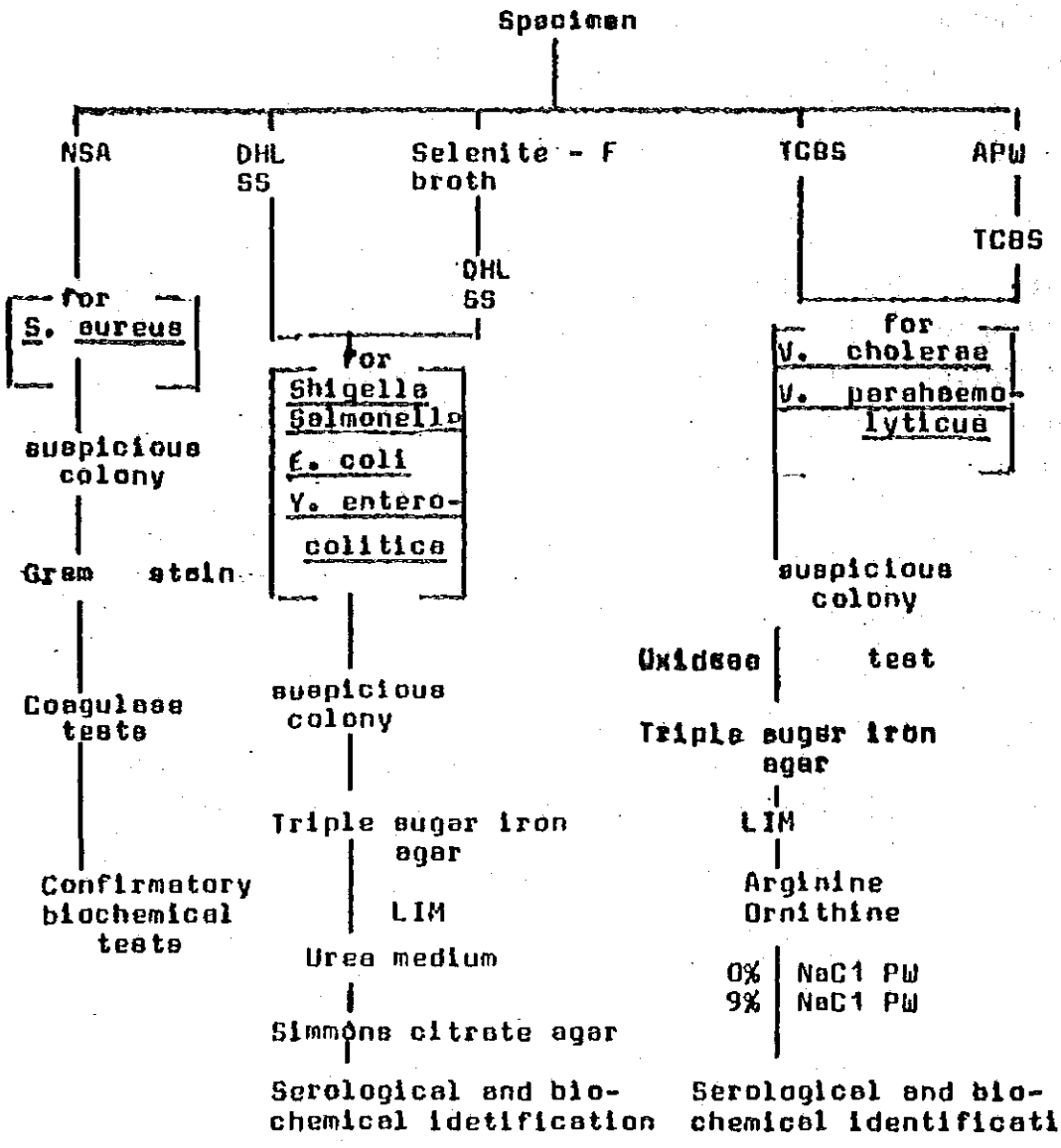
TABLE 1

Laboratory Procedures in Isolation and Identification of Pathogens



MSA - Mannitol Salt Agar; DHL - Deoxycholate Hydrogen Sulfide Agar; TCBS - Thiosulfate Citrate Bile Salt Agar; SS - Shigella-Salmonella Agar; AWP - Alkaline Pepton Water; LIM - Lisine Indole Motility Medium.

TABLE 2

ISOLATION OF ENTEROPATHOGENIC ORGANISMS
FROM DIARRHEAL CASES (27/10/1983-7/6/1984

Sex	No. of specimens Examined	Containing Pathogens	(%)
Male	219	60	(27.4)
Female	143	31	(21.7)
Total	362	91	(25.1)

TABLE 3

Number of Enteropathogenic Organisms Isolated from 91 Specimens

Total	Number of Isolated Strains			
	Shigella	Salmonella	E Coli	Others
96	30 (31%)	11 (11.0%)	35 (37%)	20 (21%

Others: H. Morganii. (4) Proteus Vulgaris. (2) K. Pneumoniae (6)
S aureus (5), Aeromonas (1) Non O - 1 V. Cholerae (2)

TABLE 4

Serotypes of Isolated *Shigella* Strains

Serotypes		No. of Isolates	
Shigella dysenteriae		2	1
		3	2
		7	1
		8	1
Subtotal			5
Shigella flexneri		1a	1
		1b	6
		2a	3
		2b	1
		3a	1
		5	1
		6	5
	Variant	x	1
	Variant	y	1
Subtotal			20
Shigella boydii		8	1
		10	1
		14	1
Subtotal			3
Shigella sonnei		1	2
Total			30

TABLE 5

Serotypes of Salmonella Isolates

O Group	No. of Isolates
B	4
E4	1
Spp	6
Total	11

* Sera were Provided by DENKA SEIKEN K.K. JAPAN

TABLE 6

Serotypes of Escherichia Coli Strains regarded as pathogenic **

Serotypes*	No. of Isolates
Enteropathogenic	28
Enteroinvasive	-
Enterotoxigenic	7
Total	35

* Number of antisera used:
  Enteropathogenic -------- 16
  Enteroinvasive -------- 7
  Enterotoxignic -------- 5

** Antisera provided by DENKA SEIKEN K.K. Japan

TABLE 7

Drug resistance of Enteropathogenic Bacterial Strains

Species	No. of Examined Strains	Resistant to: S	F	NA	CT	PN	SXT	S3	TE
Shigella	25	17	-	1	1	13	9	25	20
Salmonella	10	5	-	-	-	9	2	8	2
Escherichia coli	23	19	-	4	-	11	2	20	16
Total	58	41	-	5	1	28	13	53	38

S:Streptomycin F:f: Nitrofurantoin NA: Nalidixic Acid CT: Colisti
PN: Amicillin SXT: Co-trimoxazole S3: Compound Sulphonamide
TE: Tetracycline
- = Susceptible

Report presented during 12th Annual Conference of
Nigerian Society for Microbiology. Univ. of Nigeria,
Nusska. 7 - 9 November, 1984.

(3) - b

AETIOLOGICAL STUDIES OF INFANTILE DIARRHOEA DISEASE SEEN IN JOS UNIVERSITY TEACHING HOSPITAL: A PRELIMINARY REPORT

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ABSTRACT

A total of 589 children, 4 years and below presenting with diarrhoea at Jos University Teaching Hospital were investigated for bacterial enteropathogens from October, 1983 to September, 1984. 141 of them were investigated for Rota Virus. Coampylobacter jejuni was most frequently isolated (8.8%). Others are as follows; Shigella spp (8,5 %), Enteropathogenic E. coli (E.P.E.C.) (6.1%), Salmonella spp (2.9%), S. aureus (1.5%), Aeromonas spp (0.8%), K. oxytoca (0.7%) and non O-1, Vibrio cholerae (0.5%). One strain of E.P.E.C. was found to produce heat- labile enterotoxin(LT). 3.5 % of the number examined for Rota virus (141) was positive. No Yersinia enterocolitica has so far been isolated. The isolate are discussed to age and seasons of the year.

INTRODUCTION

Diarrhoea is a major cause of mortality and morbidity in developing countries, especially among infants. In most clinical laboratories, investigations for casative agents of acute diarrhoea are limited to the older established pathogens; Shigella spp, Salmonella spp, E.P.E.C., and Vibrio cholerae. Current reports have incriminated newer pathogens; C. jejuni (8), Y. enterocolitica (2,10), A. hydrophilla (3, 6) and Rota virus (5) This work intends to isolate and document the bacterial and viral enteric pathogens associated with diarrhoea disease.

MATERIALS AND METHODS

Stool samples were collected into Carry-Blair transport medium and prosessed with minimal delay. For isolation of C. jejuni, Skirrow's selective media was used. The plates were incubated at 42°C under microaerophilic condition for 48 hrs. This was achieved by gas pak system

without catalyst. Colonies were Gram stained for typical 'S'-shaped Gram negative bacteria. Campylobacter colonies are typically flat, glossy, effuse and have a tendency to spread along the tracks of innoculation. Organisms were tentatively considered to be Campylobacter jejuni/coli if grew at 42°C, oxidase positive, and corkscrew like motion. Other bacterial pathogens were isolated on appropriate media, biotyped and serotyped according to standard methods (9, 11).

The same procedure was also applied for Aeromonas hydrophila (9, 11) but strains were further subjected to a battery of biochemical test and Oxidasd test. The later was positive for all our strains. Haemolysin production waa also carried out on 6 % human blood Agar and zones of haemolys looked for after 24 hrs incubation.

ASSAY FOR ENTEROTOXIGENIC E. COLI

The E. coli were assayed for heat-labile enterotoxin(LT) by the Kit method(Biken Method) ... Manufactured by Meguro Institute C. Ltd. Masumi-Cho, Ikeda-Shi, Osaka Japan.

ASSAY FOR ROTA VIRUS

A sample of each stool was prepared and tested by Rota Cell, Rota Cell is reversed passive haemagglutination test Kit to detect Rota virus in stool. Rota Cell is based on the agglutination of fixed sheep red cell coated with specific antibody (to NCDV-Lincoln strain). It involves a screaning procedure and a confirmatory procedure to identify and confirm Rota virus in specimens.

RESULTS

The isolates are presented in Table 1 and 7.
A total of 50 (8.55) Shigella spp were isolated from 589 patients, 29 (10.6%) from 1-4 years old and 21 (6.7%) from under 1.

Equal number of E.P.E.C. were isolated from both age groups. Considered in this study, thirteen different serotypes were encoutered. The predominating serotype was O [illegible] (17%) followed by O 142 and O 55 (14%). C. jejui examination yielded 23 (7.1%) from ages 1 - 4. A total of six Salmonella

spp were isolated, 1 from under 1 year and 5 from 1-4 years old.

All Aeromonas species gave zones of B-haemolysis on Blood agar.

Of the 5 Rota virus found in this study. 4 were found from under 1 year and 1 from ages 1-4.

DISCUSSION

Of the four Shigella spp, Sh. flexneri was most frequently isolated (68%) and Sh. sonnei the least (2 %). This high percentage rate of Sh. flexneri is not surprising since it has been documented as the predominant species of Shigella found in Nigeria (13) . Africa has also been reported to have lower incidence of Sh. sonnei as compared to England and Wales (5,13)

Campylobacter jejuni was isolated from 8.8 % of the patient. It's incidence was higher in children below the age of 1 year. This conforms with others (8, 10). Pattern of antibiogram, reveals high susceptibility rate of C. jejuni to Chloramphenicol and Erythromycin and Kanamycin.
This agrees with other works (10).

Susceptibility of C. jejuni to Nalidixic acid, 30 ug disc, has been reported in some texts as one of the tentative identification tests (7). In this study, 1 of 18 isolates was found resistant to Nalidixic acid, 30 ug disc. Toshie Fukami reported 6 of her 60 isolates resistant to Nalidixic acid (4).

A total of 36 strains of E.P.E.C. were isolated with serotype O 26 as the most predominant (17 %) (6 of 36 isolates). In a study carried out in Lagos, serotype O 111 was the predominant strain yielding 9 out of 35 isolates (25.7%).(1)

Serotype O 111 has an incidente rate of 8.3 % in this study (3 of 36 isolates). 1 strain of E.P.E.C., O 6:K 15, was found to produce heat-labile enterotoxin (LT).

A total of 17 species of Salmonella were isolated, most of which were found among age 1-4. 1 species was isolated from the under 1 year. 5 of the 17 isolate (29 %) which belong to group B are S. typhimurium. Only 1 S. typhi was isolated. S. typhimurium has been found to be one of the commonest species of Salmonella found in Nigeria (10) and in most other parts of the world (14). A total of 141 patients were examined for Rota

virus. 5 were found positive, from whom no bacterial nor parasitic agent known to cause acute diarrhoea was found. Infants under 1 year were most infected than those between 1-4 years (4 and 1 isolates respectively). This high incident of Rota virus diarrhoea among infants under 1 year as compared with older children, 5 years and above, was recorded in other studies (5).

Generally, bacterial isolation rates tend to peak in the rainy season.

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Table 1 Bacterial isolate from acute diarrhoeal disease

MONTH	OCT.	NOV.	DEC.	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	TOTAL	% (/ TOTAL CASES)
Shigella	0	2	2	5	5	3	4	8	3	12	3	3	50	8.4889643463497
Salmonella	0	1	0	1	1	2	7	0	0	2	1	2	17	2.8862478777589
E.P.E.C.	1	0	1	2	4	3	4	5	2	10	2	2	36	6.1120543293718
C. jejuni	—	—	—	—	—	—	—	2/20	3	9	5	4	23	8.7786259541984
Y. entero.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Vibrio spp	0	0	0	0	0	0	0	2	0	0	1	0	3	5.0933786078e-1
K. oxytoca	0	0	1	1	0	1	0	0	0	0	1	0	4	6.7911714770e-1
S. aureus	0	1	1	0	0	2	1	1	0	1	0	1	8	1.3582342954159
Aeromonas spp	0	0	0	0	0	0	0	1	1	0	1	2	5	8.4889643463e-1
Others	0	1	2	2	0	1	4	0	0	0	0	0	10	1.6977928692699
POS. CASES	1	5	7	10	10	10	18	17	8	27	14	13	140	2.37691001697e1
NEG. CASES	12	48	30	22	43	44	33	37	24	49	61	46	449	7.62308998302e1
TOTAL CASES	13	53	37	32	53	54	51	54	32	76	75	59	589	

Table 2 Incidence of Enteropathogenic Organisms according to Age Group

Age (years)	No. of cases examined	No. of positive cases (%)	Shigella	Salmonella	E.P.E.C.	C. jejuni
Under 1	315	63 (20.0)	21 (6.7)	3 (1.0)	18 (5.7)	12/106 (11.3)
1 - 4	274	77 (28.1)	29 (10.6)	14 (5.1)	18 (6.6)	11/156 (7.1)
Total	589	140 (23.8)	50 (8.5)	17 (2.9)	36 (6.1)	23/262 (8.8)

Table 3 Serotypes of Shigella strains isolated

Serotypes		No. of Isolates
Shigella dysenteriae	2	1
	3	2
	7	2
	8	1
	* UT	1
Sub Total		7
Shigella flexneri	1a	2
	1b	10
	2a	6
	2b	1
	3a	3
	4a	4
	5	1
	6	7
Sub Total		34
Shigella boydii	8	1
	10	1
	14	2
	15	2
Sub Total		6
Shigella sonnei		3
Total		50

* Untypable strains

Table 4 . Serotypes of Salmonella strains isolated

O group	No. of isolates
B	5
B1	1
C2	1
D1	2
E4	1
typhi	1
* UT	6
Total	17

* Untypable strains

Table 5

Serotypes of Enteropathogenic E. coli isolated

Serotypes	No. of Isolates
O 26: K 60	6
O 142: K +	5
O 55: K 59	5
O 127a: K 63	4
O 111: K 58	3
O 86a: K 61	3
O 126: K 71	2
O 44: K 74	2
O 128: K 67	2
* O 6: K 15	1
O 114: K 90	1
O 125: K 70	1
O 148: K +	1
Total	36

* Heat-labile enterotoxin (LT) positive strain

Table 6 Drug Resistance of Enteropathogenic Bacteria strains

Species	No. of isolates examined	Resistant to: SM	F	NA	CT	ABPC	SxT	Su	TC	KM	CM	EM
Shigella	43	34	0	1	2	26	18	43	34	2/18	7/18	-
Salmonella	15	5	0	0	0	4	4	12	3	1/5	0/5	-
E.P.E.C.	30	19	0	1	0	11	5	25	15	4/14	6/14	-
C. jejuni	22	3	0	1	6	2	11	2	1	0	0	0

SM: Streptomycin, F: Nitrofurantoin, NA: Nalidixic Acid, CT: Colistin Sulphate, ABPC: Ampicillin, SxT: Co-Trimoxazole, Su: Compound Sulphonamide, TC: Tetracycline, KM: Kanamycin, CM: Chloramphenicol, EM: Erythromycin

Table 7 Incidence of Rota virus according to Age Group

Age (years)	No. of cases examined	Rotavirus positive cases	(%)
Under 1	58	4	(2.8)
1 - 4	83	1	(0.7)
Total	141	5	(3.5)

Table 8 Cases of Multiple Infection

Shigella + E.P.E.C.	4
Shigella + Salmonella	1
Shigella + C. jejuni	1
Shigella (2) + C. jejuni	1
Shigella + E.P.E.C. + C. jejuni	1
Shigella + Aeromonas	1
C. jejuni + E.P.E.C.	1
Total	10

Fig 1 Incidence of Enteropathogenic Organism according to season

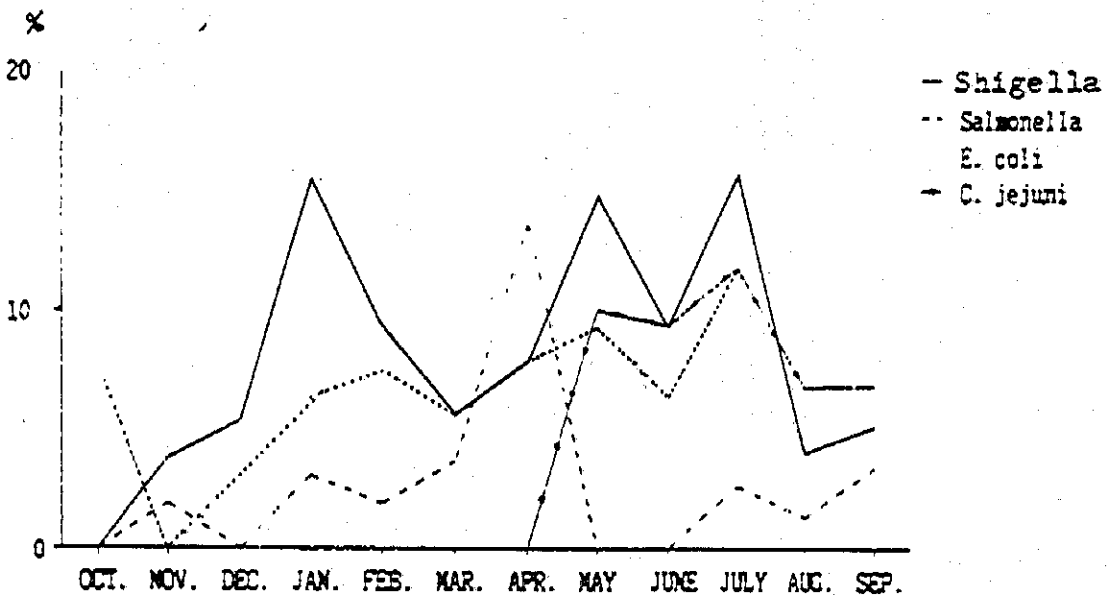
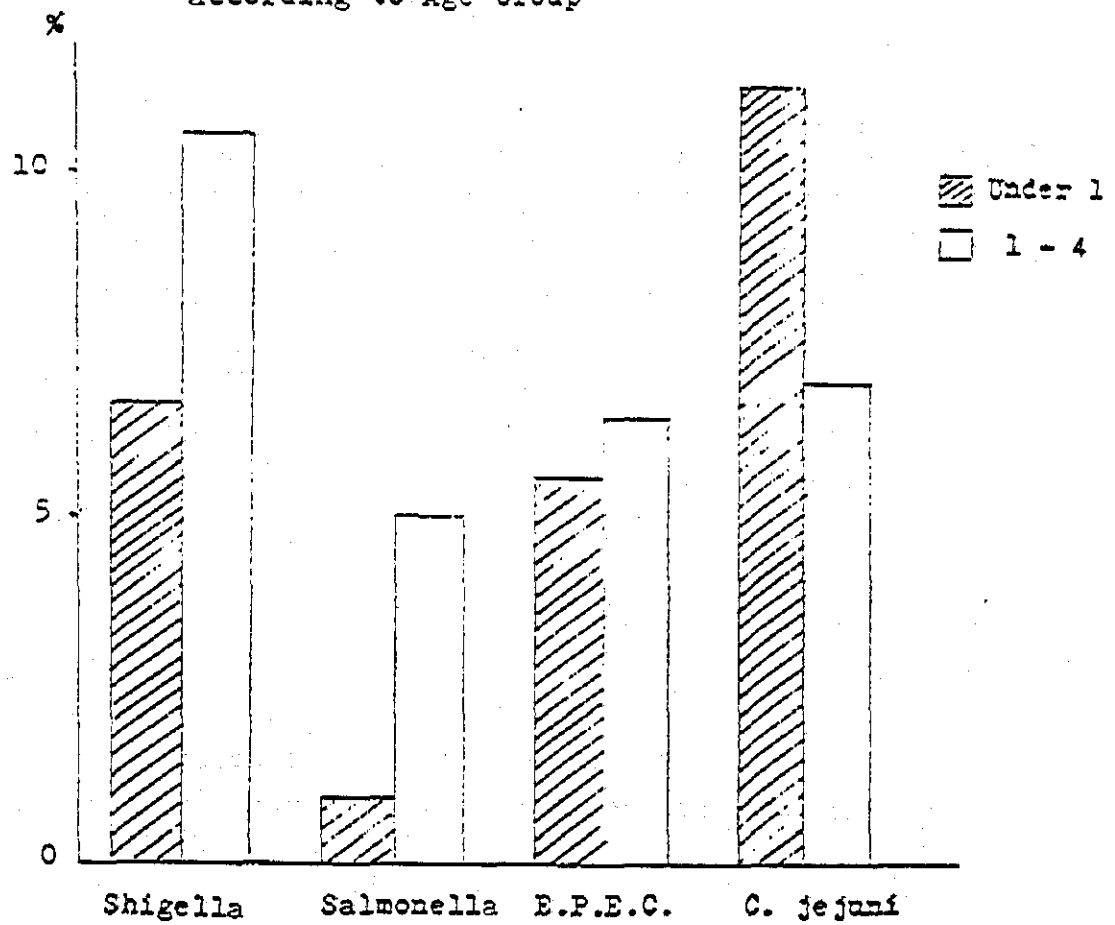


Fig 2 Incidence of Enteropathogenic Organisms according to Age Group



Data on clinial Presentation, Environmental and Socio-Demographic Profile of Diarrhoea Cases.

(JICA-UniJos Research Project on Diarrhoea in under five Children)

Dr. u. P. Nwene.
Department of Community Health.

The Project Report for 1983 had outlined the objectives and methodology of study, plan of action, phasing of the project and other details. It was stated in report that epidemiological aspect of the study involving community study of diarrhoea in children under five years will be carried out in the second phase of the study to be undertaken from the last quarter of 1984. Meanwhile clinical presentation and socio-demographic, and environmental aspects of the cases of diarrhoea in children under five attending different units of Jos University Teaching Hospital and Plateau Hospital was collected to supplement the data of Microbiological examination.

Table below shows the number of diarrhoea cases studied during 1983 and first half of 1984.

Hospital Unit	1983		1984	
	With Positive Isolation	Negative	With Positive Isolation	Negative
JUTH Paediatric Ward	4	23	10	18
JUTH General O.P.D.	11	40	15	30
JUTH Child Health Clinic	40	87	17	61
Plateau Hospital Wards	1	6	3	-
	56	156	45	109

Cards for 2 cases are missing and hence only 43 have been analysed.

All the diarrhoea cases with positive isolations during 1984 have been analysed for clinical presentation and socio-demographic and environmental data. An equal number of diarrhoea cases from each of the units but without positive isolation were randomly selected and also analysed. The data are presented in Tables 1 to 8 at the end of this report.

The following observations are made from the data.

1. Data analysis included 43 cases of diarrhoea with the isolation and 44 cases without positive isolation.
2. Of the 87 cases of diarrhoea studied 36 (41.4%) were infants below one year, and another 19.1% were between 1-2 years. Thus children below 2 years constituted 80.5 % of all cases.

3. Two thirds (66.6%) of all cases were male while remaining were female. This difference could be due to male children being given more care by mothers and therefore seeking medical attention rather than greater prevalence of diarrhoea among male children.

4. More than half (55.5%) of the children gave history of suffering from diarrhoeal attacks in the past 2 months before the present attack, showing that these children are prone to repeated attacks. Children with isolations had positive isolation (60.5% against 50.0% respectively).

5. Sixty percent of the cases had five or more passage of stools per day. However higher proportion of children (73.0%) with positive isolation had larger number of bowel evacuations than the negative isolation cases (46.3%).

6. Passing of watery stool (9.9%), mucus (67.8%) and or blood (31.0%) were the usual presenting symptoms. Fever was present in 63.2% of cases. Of the 10 cases admitted in paediatric ward 52.4% had mild to moderate dehydration on admission while one had sever dehydration.

7. It is important to note that about half (49.4) of cases had already taken treatment from one or other qualified medical personnel before their consultation to JUTH or Plateau Hospital. This could mean consumption of antibiotics leading to lower isolation rate.

8. Majority(87.0%) of the children belonged to lower socio-economic group. Overcrowding(63.2%) in the house, absence of safe water supply(13.8%) and sanitary latrine (80.5% did not have) were the environmental features amongst the cases.

9. Only 17.2% of children were fed on breast alone, the remaining were on top feed. 69% of the mothers did not sterilise the bottle/ utensil of the child while 52% did not boil their drinking water.

10. History of presence of another case of diarrhoea was forthcoming in 18.7% of cases suggesting that the transmission could have been intra-familial.

The above data for 87 cases only are presented to highlight socio-demographic and environmental characteristics of cases of diarrhoea besides the clinical presentation. They, however, suffer from the demeris of any data derived from the hospital/clinics. An enquiry covering the field collection of data can only give the much needed epidemiological profile of the cases. The department is getting ready for the same and experts to start the epidemiological studies from last quarter of the present year.

Table 1. Age and Sex-wise Distribution of Diarrhoea Cases.

Age (Yrs)	Cases		Sex	Cases	
	No.	%		No.	%
1	36	41.4	Male	58	66.6
1-	34	39.1	Female	29	33.3
2-	11	12.6			
3 - 5	6	6.9			
Total	87	100			

Table 2. History of Diarrhoea within last 2 months

History	Cases with bacterial isolation		Cases without isolation		Both	
	No.	%	No.	%	No.	%
Present	26	60.5	22	50.0	48	55.5
Absent	17	39.5	22	50.0	39	44.8
	43	100	44	100	87	100

Table 3. Frequency of passing stools.

Frequency/day	Cases with bacterial isolation		Cases without isolation		Both	
	No.	%	No.	%	No.	%
5 times	11	26.8	22	53.7	33	40.2
5 - 10 times	23	56.0	13	31.7	36	43.9
1- +	7	17.0	6	14.6	13	31.7
	41	100	41	100	82	100

Table 4. Clinical Presentation of CAses of Diarrhoea

Symptpms	No. (n= 87)	%
Watery/Sof stool	80	91.9
Mucus in stool	59	67.8
Blood in stool	24	31.0
Vomiting	37	42.5
Fever	55	63.2
Pain in abdomen	28	32.2

Note - 1. 52.4% of cases had mild to moderate dehydration.

2. 49.4% of cases had already taken modern drugs for diarrhoea bdfore coming to hospital while 17.2% had taken native medicine.

Table 5. Socio-economic Status of the Families.

S.E.Status	No.	%
High	10	13.0
Middle	34	44.2
Low	33	42.8

Note - Socio-economic status was determined by the occupation of father and mother. Low included manual or semi-skilled workers, middle included skilled workers, office workers etc, while high included professionals, university teachers, businessmen of high standing etc.

Table 6. Environmental Sanitation in the Families.

Sanitation Status	No (n = 87)	%
i) Overcrowding in house	55	63.2
ii) Water supply from well/stream	12	13.8
iii) Absence of sanitary latrine	69	80.5

Table 7. Feeding Practices of the Children

Feeding	No.	%
Breast alone	15	17.2
Bottle	14	16.1
Breast + Bottle	20	23.0
Bottle + Solids	13	14.9
Solids only	18	20.7

Note - 31% of mothers did not sterilise the feeding bottles while baby's water was not boiled by 52.9% mothers.

Table 8. Presence of other Diarrhoea Cases in the Family

Diarrhoea Cases	No.	%
Present	14	18.7
Absent	61	81.3
	75	100

DEPARTMENT OF ZOOLOGY
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SECOND ANNUAL PROGRESS REPORT OF THE RESEARCH PROJECT TEAM ON MEDICAL ENTOMOLOGY AND PARASITOLOGY IN COLLABORATION WITH THE JAPANESE INTERNATIONAL COLLABORATIVE AGENCY (J.I.C.A.) PROJECTS 1983/84

As a follow-up to the first Annual Report on the JICA - UNIJOS Collaborative Projects on Medical Entomology, and Parasitology, the following is the Progress Report so far for the 1983/84 period.

Altogether nine (9) academic staff, and six (6) Postgraduate Research students participated in the Projects from October 1983 to September 1984. They consist of the following:

Professor M.O.E. Iwuala	Department of Zoology
Dr. D.M. Roberts	" " "
Dr. R. Irving Bell	" " "
Dr. C.O.E. Onwuliri	" " "
Dr. J. Akoh	" " "
Mr. G.E. Anyanwu	" " "
Professor I.C. Tiwari	Department of Community Medicine
Mr. R.O.A. Shonekan	Department of Medical Microbiology
Dr. H. Takahashi	J.I.C.A. Research Project

Postgraduate Students

Mr. M. Maduabum	Department of Zoology
Mr. D. Boakye	" " "
Dr. I.A. Lawal	" " "
Mr. B.E. Mwoke	" " "
Mr. I. Sesay	" " "
Mr. J.A. Ogidi	" " "

A total of eleven (11) sub-projects were mapped out for investigation work (i.e. inclusive of the earlier six sub-projects covered in the 1982/83 Report).

The position so far regarding each Project is as follows:

PROJECT 1: "Study of distribution of Blackflies (Simulium species) on the Jos Plateau"
- Prof. M.O.E. Iwuala, Mr. M. Maduabum, and Dr. H. Takahashi

Introduction

During the phase I aspect of this study, a total of 13 rivers in the Upper Plateau area were consistently sampled for black-fly breeding over an eight month period (April - November, 1983)

Three of the rivers (River Assob, River Farin Ruwa and Gambo River) were the only ones found positive for Simulium breeding, and the greatest intensity of breeding was recorded between June and August, 1983.

Recent Work

The bi-weekly sampling exercise was maintained from November 1983 till the end of September, 1984. Also the physical characteristics of the various rivers (especially their P^H, temperature, Dissolved oxygen, and conductivity measurements) have been monitored on a regular basis over the past year. Such river measurements as flow rate, depth and width etc. were also considered.

Results

At the moment, a total of nine species of Simulium have been recorded from the various rivers. These are S. adersi, S.alcocki, S. aureosimile, S. cervicornutum, S. colas-belcouri, S. hargreavsi, S. macmahoni, S. schoutedini and S. vorax. Most of these were found in River Assob, with a few species recorded from Rivers Farin ruwa and Gambo.

Physico-chemical measurements from the Rivers showed the PH range to vary between 8.05 and 9.2. Oxygen concentration in ml/litre ranged from 2.45 to 9.6, with significant fluctuations recorded for various rivers in different months. The conductivity measurements were exceedingly low for most rivers, but fairly high in the case of Rivers Assob, Mangu and R. Foron. As for temperature measurements, this remained fairly consistent for most of the period, with the range being between 22^{oc} and 34^{oc}.

Future Work

In extension of this work, it is intended to study in detail the seasonality of breeding and the factors conditioning the spread and activities of the black-flies in and around the rivers in the Upper Plateau area.

PROJECT 2: "Effect of Water Velocity On The Relative Abundance Of Immature Black-Flies

- Dr. D.R. Roberts and an M.Sc. Student

Introduction:

Unbiased sampling of immature black-flies is extremely difficult because of the highly localised distribution of the different species within the river. This seems to be primarily due to:-

a) Localised substrate differences - this has already been studied by Dr. D.H. Roberts;

b) Localised differences in the water velocity - this will be studied in the present project, to find the prefered water velocity of each species during their larval and pupal stages.

Method:

The water velocity meter only arrived at the beginning of the wet season, so the experiment cannot start until the end of the next dry season (January - March 1985 when the water velocity will be stable. The equipment has however been tested in the River Assob. 20 sites will be chosen in the river (five different velocity ranges, with four replicates for each) and the black-flies will be trapped using polythene string substrates, which will be replaced every two weeks for six replicates.

PROJECT 3: "Effect Of Temperature And Humidity On Black-Fly Pupal Survival"

- Dr. D.H. Roberts, Mr. D.A. Boakye, Mr. J.A. Ogidi

Introduction:

Two experiments have been carried out:

1. On low temperatures: Transport of pupae from the field to the laboratory requires:- a) Prolonging the pupal stage as far as possible using low temperatures, but at the same time; b) obtaining maximum survival and minimum after effects to the adult. The optimum conditions were investigated in this experiment.
2. On high temperatures: Under natural conditions, the pupae may be exposed to the air for several days due to changes in the water level and they should therefore have evolved a tolerance to high temperatures. This is investigated in the second part of the experiment.

Results:

Exp. 1 (Low temperatures)

The project started in January 1983. Four temperatures were tested:- 0, 4, 8 and 12°C, to study their effect on pupal survival, adult emergence and adult longevity in Simulium squamosum (a member of the S.damnosum complex). The pupae were exposed to these temperatures for different time periods between 1 - 7 days, then returned to the ambient temperature (approx. 20°C). Survival was greatest at 8°C and lowest at 0°C. When the pupae were divided into young (with pale cuticles)

The Kagoro River (110 km. from Jos) where it passes through an isolated patch of rain forest over a granite boulder bed; this is at the base of the Jos Plateau.

Research Staff

A co-ordinated study is being undertaken by:
Dr. R.J. Irving-Bell, Senior Lecturer, who is sampling the Assob River site; Mr. I. Sosay, an M.Sc. student who has undertaken the sampling of the Kagoro River site for part of the year, as his research project under the supervision of Dr. Irving-Bell.
Mr. Sosay is in receipt of a W.H.O. student award.

Method

Monthly or bi-monthly sampling of both sites began in January 1984. Initial breeding habitats available were rock pools and mud pools. In March additional habitats in the form of tree holes and leaf axils became water-filled owing to the early start of the rains.

The trees/shrubs comprising the habitats have been identified, courtesy of Dr. P. Buckley, Dept. of Geography. Unfortunately the leaf axil habitats available are limited to Pandanus sp., only at the Assob. At the Kagoro site, the bannana plants and oil palms present nearby did not retain water in their leaf axils.

Interim Results

A. KAGORO RIVER SITE

Mr. Sosay has completed 10 visits (sampling occasions) from Jan. to June. His thesis entitled "Mosquito breeding habitats: Distribution and relative abundance of species at a Kagoro forest stream in Northern Nigeria" is currently undergoing examination. A copy of his abstract is attached.

No sampling was possible in July and August owing to lack of transport. Dr. Irving-Bell has resumed sampling of this site from September using private transport.

B. ASSOB RIVER SITE

Samples collected so far are shown in Table 1. Species identifications for the collections of Jan. to May have been completed; a list of species is given by Table 2. Reference collections of (a) pinned adults, (b) larvae in lactophenol and (c) males in ethanol, have been made.

Anticipated procedure for project completion

1. Monthly collections at both sites will continue until Dec.1984.
2. The difficulties in taxonomy need to be resolved. Dr. Irving-Bell

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TABLE 1. MOSQUITO SAMPLES COLLECTED JAN. - OCT. 1984 (ASSOB RIVER SITE)

Sampl. occ.:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Date:	Jan. 27th.	Feb. 1st.	Feb. 22nd.	Feb. 29th.	Mar. 18th.	Mar. 29th.	Apr. 26th.	May 5th.	May 15th.	June 2nd.	June 24th.	July 15th.	Aug. 18th.	Sept. 18th.	Oct. 28th.
	— ROCK POOLS —														
No.of pools*	5	5	6	5	5	5	5	5	2	5	2	2	0	5	5
$\bar{x}$ mosquitoes/pool	233	447	140	145	196	230	118	44	36	124	5	53	-	63	159
	— MUD POOLS —														
No.of pools*	7	5	5	5	4	5	5	5	3	5	3	3	0	3	5
$\bar{x}$ mosquitoes/pool	58	192	134	79	77	84	140	17	8	41	227	5	-	3	112
	— TREE HOLES —														
No.of samples**	-	-	-	-	-	-	5	5	6	5	5	6	5	5	5
$\bar{x}$ mosquitoes/ sample							20	18	9	19	11	7	8	11	1
	— LEAF AXILS —														
No.of samples***	-	-	-	-	-	-	5	2	5	5	5	5	5	5	5
$\bar{x}$ mosquitoes/ samples	-						3	3	27	63	43	67	28	30	32

* Those pools with larvae + pupae, i.e. excluding barren pools or pools with only mosquito eggs.

** One sample = ½ cup of tree hole water

*** One sample = water from 10 leaf axils of Pandanus

PPROJECT 5:

Mosquitoe breeding habitats: Distribution and relative Abdunace of Species at a Kagoro forest in Northern Nigeria.

Dr. R.J. Irbing-Bell and Mr. I. Sesay

Studies were carried out to determine the distribution and relative abundance of immature stages of mosquitoes associated with a stream in Kagoro Forest, a Northern guinea savanna rain forest. The effects of season and other environmental parameters such as water depth, pH, predators, dissolved organic matter, nitrates and water colour, on the occurrence and abundance of immature stages were also determined. The habitats studied were rock pools, mud pools and tree holes. Each habitat when available, was sampled once or twice monthly from January to June 1984. Culex decens was the most abundant species, followed by Anopheles rhodesiensis. Cx. dutteni and Cx. univittatus were the least encountered, followed closely by Cx. trifilatus. Rock pools were generally more productive with slightly higher temperatures and fewer predators than mud pools. The occurrence of some species was observed to be related to season, for example, Aedes vittatus which was encountered in rock pools as expected, and tree holes. Uranotaenia mashonaensis was present only in the wet season. Cx. decens and Cx. tigripes on the other hand, were observed to be absent in mud pools during the wet season. An.rhodesiensis in mud pools, and Cx. decens in rock pools, were not observed to be affected by season with regard to occurrence, but their abundance was conspicuously reduced in the wet season.

From results obtained on the analysis of the effects of depth, pH, predators, dissolved organic matter, nitrates and water colour, none was found to be a significant factor in determining abundance of immature stages of mosquitoes in rock pools. However a significant difference was obtained in the abundance of immature stages of mosquitoes between rock pools and mud pools.

TABLE 2. LIST OF SPECIES IDENTIFIED, JAN. TO MAY, WITH PRESENCE (+) BY HABITAT (ASSOD RIVER SITE)

	ROCK POOLS	MUD POOLS	TREE HOLES	LEAF AXILS
Anopheles				
barberellus?		+		
funestus		+		
gambiae s.l	+	+		
pretoriensis	+	+		
rhodesiensis	+	+		
rufipes	+	+		
Uranotaenia				
fusca	+	+		
mashonaensis	+	+		
ornata				+
shillitonis?				+
Aedes				
aegypti	+		+	
africanus?			+	
apicoargenteus			+	
bambusae?			+	
fowleri	+			
furcifer?			+	
helschi?				+
lamborni			+	
lutzocephalus			+	
simpsoni			+	+
stokesi			+	
vittatus	+			
Culex				
annulioris		+		
bitaeniorhynchus		+		
cinereellus	+		+	
decens	+	+		
duttoni	+			
ethiopicus		+		
fatigans	+	+		
horridus			+	
insignis?	+	+		
nebulosus			+	
salisburiensis		+		
sinaiticus?	+	+		
simpsoni	+	+		
tigripes	+	+		
trifilatus	+	+		
univittatus	+	+		

? = not confi[illegible] presence of adults.

9/...

has consulted two experts in the U.K. and has collected reprints on new species of Culex and Aedes described from West Africa since the publication of the major taxonomic reference book by Edwards in 1941. She has applied to the Commonwealth Institute of Entomology for further reprints, using personal funds. The following procedure is required: (a) Translation of papers from French to English; (b) Permanent mounts of larvae and male genitalia to be prepared for reference and confirmations of identities.

3. Analyses of results. These will include a comparison of the two sites, and an examination of the relationships between species and habitat characteristics, as well as analysis of abundance in relation to predators and rainfall.

Difficulties

1. Lack of readily available transport or funds for use of personal vehicle.
2. Shortage of specimen tubes, rearing containers and insect boxes.
3. Difficulties and no financial help for the acquisition of literature and translations.
4. Lack of expert technical help for e.g. preparation of reference slides and pinned specimens.
5. Lack of computer facilities for quick analyses of data.

PROJECT 5: "Seasonal and Vertical Distribution Of Tree-hole Mosquitoes"

The most suitable site for this study is the Kagoro Forest 110 km. from Jos. The project cannot be undertaken unless transport is guaranteed, and unless an M.Sc. student is willing to undertake the study. Assuming that these conditions are satisfied, it is envisaged that oviposition traps would be constructed and positioned over the period Jan. to March 1985, and that sampling be performed in the wet season from March/April, continuing over the first half of the following dry season to December, 1985.

PROJECT 6: "The Prevalence and Distribution Of Onchocerciasis On The Jos Plateau"

- Dr. C.O.C. Onwuliri, Dr. I... Lawal and B.E. Nwoke

Eight villages on the foot of Jos Plateau, Nigeria located at various distances from the Assob River have so far been surveyed for the prevalence and distribution of human onchocerciasis.

7/...

A total of 1077 people were examined out of which 177 (10.86%) had Onchocerca volvulus microfilariae in their skin snips. The highest infection rate was obtained in a small settlement, Atukum Tozo II where 10(27.8%) of 36 persons examined showed positive skin-snips. At Nadaki 24.14% of the people were infected. It was apparent that villages closer to the river had higher infection rates than villages farther away. Consequently in Atukum Tozo II which was only about 1 km from the river 27.8% infection rate was recorded, whereas in Dogon Fili 3.5 km away, the infection rate recorded was only 1.2%.

There was no significant difference in infection ratesbetween males and females in some of the villages since both groups have equal chances of being bitten by infected flies. However, the overall infection rate was higher in males than females. 554 females have so far been examined, of which 52 (9.40%) had infection and 65 (12.40%) of the 523 males examined were infected.

Work is still in progress for other aspects of this project while additional villages are surveyed for onchocerciasis.

PROJECT 7: "Study of the seasonal abundance and population characteristics of immature stages of black-flies in Jos Plateau Area"

- Prof. P.O.E. Iwuala, Mr. M.A. Maduabum and Mr. H. Tal Dashi

Introduction and Methodology:

As a follow-up to preliminary studies on the distribution of black-flies in the Upper Plateau area (see Project 1), quantitative studies on the seasonal abundance of different types of black-flies breeding in the River Assob (Riyom L.G.A., Plateau State) was commenced in November, 1983.

Larvae and pupae of the insects were sampled on a regular forthnightly basis using polythene strips and Borassus palm fronds as substrates.

Also natural trailing vegetation found at the banks of the river were sampled for the immature stages of the black-flies. Other forms of fauna closely associated with the immature insects were collected from the water and from submerged rock surfaces for study and assessment.

The quantitative sampling was undertaken consistently from November 1983 to the end of September, 1984 on a regular bi-weekly basis.

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Results/Observations

The results of the sampling of immature simuliids are summarised in tables 1 - 4.

Table I below indicates the relative abundance of Simulium pupae collected per $90cm^2$ on the two substrates of polythene strips and Borassus palm fronds respectively for the period November 1983 to March, 1984.

Blackfly species	Nos/$90cm^2$ on substrates: Polythene strips	Borassus Palm Frond	Overall Total
S. hargreavesi	409	433	842
S. Cervicornutum	97	53	150
S. [illegible]	29	20	49
S. schoutedini	16	17	133
S. alcocki	36	29	65
S. [illegible]	9	3	12
S. adersi	0	3	3
S. colas-belcouri	4	7	11
S. aureosimile	9	17	26
S. walshi	0	1	1
TOTAL -	609	583	1192

TABLE 2 SEASONAL CLINES OF SIMULIID PUPAE ON POLYTHENE STRIP SUBSTRATE FROM ALL THE SITES (I, II & III)

Species	YEAR 1984 APR	%	MAY	%	JUN	%	JUL		OVERALL TOTAL
S. hargreavesi	55	90.164	68	83.951	11	68.75	0		134
S. cervicornutum	3	4.918	10	12.346	5	31.25	0		18
S. schoutedini	0		2	2.469	0		0		2
S. alcocki	2	3.279	1	1.234	0		1	100	4
S. [illegible]	1	1.639	0		0		0		1
S. damnosum s.l	0		0				0		0
MONTHLY TOTAL	61		81		16		1		159

12/..

TABLE 3: SEASONAL CHANGES OF SIMULIID PUPAE ON BORASSUS PALMYRA FROND SUBSTRATE FROM ALL THE SITES (I,II & III)

	YEAR 1984								
Species	APR	%	MAY	%	JUN	%	JUL	%	OVERALL TOTAL
S. hargreavesi	45	83.333	48	85.714	20	80	0		113
S. cervicornutum	7	12.963	7	12.500	3	12	1	25	18
S.schoutedini	0		1	1.706	1	4	1	25	3
S. alcocki	2	3.704	0		0		0		2
S. vorax	0		0		0		0		0
S. damnosum s.l	0		0		1	4	2	50	3
MONTHLY TOTALS	54		56		25		4		139

TABLE 4:Results of the sampling of natural vegetation for the period April to July 1984 are shown below:

	YEAR 1984								
Species	APR	%	MAY	%	JUN	%	JUL	%	OVER-ALL TOTAL
S. hargreavesi	16	88.888	81	91.011	12	70.589	13	27.660	122
S. cervicornutum	1	1.556	6	6.741	1	5.882	0		8
S.alcocki	0		1	1.124	1	5.881	0		2
S. vorax	1	1.556	0		3	17.647	14	29.787	18
S. schoutedini	0		1	1.124	0		0		1
S. damnosum S. l	0		0		0		20	42.553	20
MONTHLY TOTALS	18		89		17		47		171

Results of the rock faunal collections showed Coleopteran beetles (Family Psephenidae) and Ephemeropteran larvae (Family Heptagenidae) to be the most preponderant forms associated with the immature simulids. A few forms of Odonata and Plecoptera were also recorded at the breeding sites of the insects.

Further Investigations

The quantitative sampling of the simuliidae will be stepped up in subsequent months of the 1984/85 period. Also potential biological control agents will be collected and screened from water samples in the insects' breeding sites.

PROJECT 8: "Effect Of Predators and Type Of Substrate On the Relative Abundance Of Immature Black-Flies"

- Dr. D.M. Roberts & Mr. J.O. Davies-Cole

Introduction

Preliminary studies on the effect of substrate flexibility on black-fly abundance seemed to show that inflexible substrates were colonised by predators and so had few black-flies. Consequently, the relationship between the flexibility of the substrate, predator abundance and black-fly abundance was studied.

Results:

Five types of substrate with different degrees of flexibility were tested:- inflexible, inflexible but articulated, limited flexibility, flexible in one plane, flexible in several planes. Colonisation of these substrates was compared in two ranges of water velocity:-

1. High water velocity. This experiment was carried out in January - March 1984. 8 black-fly species were collected, but the three most abundant were: Simulium hargreavesi, S.vorax and S.cervicornutum. S. vorax prefered the inflexible substrates; S.hargreavesi prefered the inflexible but articulated substrates; S.cervicornutum had no significant preference. Very few predators were collected in these high water velocities, so that they are unlikely to have affected the the relative abundance of the black-flies.
2. Moderate water velocity. This experiment will be carried out in January - March 1985 (by Dr. D.M. Roberts). It is expected that the predators will be much more abundant in these velocities and thus affect the black-flies substrate preferences.

Publication:

1. Davies-Cole J.O. (1984) - Investigations on the effect of substrate flexibility and predators on the relative abundance of the immature stages of the black-fly (Diptera: Simuliidae).

PROJECT 9: "Dispersal Of Adult Black-Flies"

- Dr. D.M. Roberts & Dr. R.J. Irving-Bell

Introduction

Little is known about the dispersal of black-flies, because collecting has largely been limited to using human bait. Information from this is extremely limited because:-

a) Only a small part of the population is being sampled (the biting females).
b) The method is highly biased, being very vulnerable to differences in the attractiveness and efficiency of the collectors, and to local microhabitat differences.

In this experiment, vehicle-mounted nets will be used, which have the advantage of:-

a) being unbiased and therefore sampling the whole population.
b) being very efficient in collecting black-flies at low densities.

Method:

The experiment cannot start until the equipment is received from JICA. It is hoped to start at the end of 1985. Two vehicles with nets mounted on their roof racks will be driven in opposite directions along a 20 km stretch of road at right angles to the river Assob. The catch will be emptied every 2 km, so that the fly abundance will be monitored at 2 km intervals away from their breeding site.

PROJECT 10: "Niche Distribution In Relation To Physiological State Of Adult Populations Of Black-flies And Mosquitoes"

- Dr. R.J. Irving-Bell

This study requires extensive preliminary work in testing the methods proposed, particularly with regard to black-fly collecting. The components for constructing a mechanical aspirator have not yet arrived (see method A). With regard to method B, the use of artificial resting shelters, these have been found to be effective for the collection of resting mosquitoes in the dry season on the University Campus; however small covered buckets were used rather than the cardboard boxes proposed. Since plastic buckets are attractive to petty thieves, it is proposed that a preliminary trial using cardboard boxes is carried out in a woodland site near the University. This is necessary to determine the number needed to obtain reasonable sample sizes, and also to decide on sampling frequency.

Therefore the project as outlined in the proposal is unlikely to begin until Oct./Nov. 1985, by which time it is hoped preliminary trials will have indicated a suitable experimental design.