JOSH GREEN, M.D.
Governor

SYLVIA LUKE
Lt. Governor

SHARON HURD
Chairperson
Board of Agriculture & Biosecurity

DEAN M. MATSUKAWA
Deputy to the Chairperson

State of Hawai'i
DEPARTMENT OF AGRICULTURE & BIOSECURITY
KA 'OIHANA MAHI'AI A KIA'I MEAOLA
1428 South King Street
Honolulu, Hawai'i 96814-2512
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TESTIMONY OF SHARON HURD
CHAIRPERSON, BOARD OF AGRICULTURE AND BIOSECURITY

BEFORE THE HOUSE COMMITTEE ON ENERGY & ENVIRONMENTAL PROTECTION AND AGRICULTURE & FOOD SYSTEMS

THURSDAY, FEBRUARY 12, 2026
10:20 AM
CONFERENCE ROOM 325 & VIDEOCONFERENCE

HOUSE BILL NO. 1617
RELATING TO TAXATION

Chairs Lowen and Chun, Vice Chairs Peruso and Kusch, and Members of the Committees:

Thank you for the opportunity to testify on House Bill No. 1617 Relating to Taxation. This bill re-establishes the Agricultural Development and Food Security Special Fund and establishes the Carbon Emissions Tax and Dividend Special Fund. Increases the Environmental Response, Energy, Carbon Emissions, and Food Security tax rates over time and establishes a refundable carbon cashback tax credit to offset increases for most taxpayers. Requires reports to the legislature. The Department of Agriculture and Biosecurity (Department) supports the intent of the bill and defers to the Department of Taxation.

The loss of the agricultural development and food security special fund in 2021 weakened the ability of the Department to fully support agricultural development in the state. Monies from the fund were used to support new farmer development, marketing efforts, disaster relief and emergency irrigation systems repairs and agricultural/aquaculture research.

The vulnerability of the world's food supply and the state's geographic isolation provides strong motivation towards increasing food self-sufficiency. If agriculture is to increase in the state we will need to provide greater support for the industry, and the re-establishment of the Agricultural Development and Food Security Special Fund is a critical step in that direction.

Thank you for the opportunity to testify on this measure.

JOSH GREEN, M.D.
GOVERNOR | KE KIA'ĀINA

SYLVIA LUKE
LIEUTENANT GOVERNOR | KA HOPE KIA'ĀINA

STATE OF HAWAIʻI | KA MOKUʻĀINA ʻO HAWAIʻI
DEPARTMENT OF LAND AND NATURAL RESOURCES
KA ʻOIHANA KUMUWAIWAI ʻĀINA
P.O. BOX 621
HONOLULU, HAWAII 96809

DAWN N.S. CHANG
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

RYAN K.P. KANAKAʻOLE
FIRST DEPUTY

CIARA W.K. KAHAHANE
DEPUTY DIRECTOR - WATER

AQUATIC RESOURCES
BOATING AND OCEAN RECREATION
BUREAU OF CONVEYANCES
COMMISSION ON WATER RESOURCE MANAGEMENT
CONSERVATION AND COASTAL LANDS
CONSERVATION AND RESOURCES ENFORCEMENT
ENGINEERING
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION
KAHOOLAWE ISLAND RESERVE COMMISSION
LAND
STATE PARKS

Testimony of
LEAH LARAMEE
Climate Change Coordinator on behalf of
Climate Change Mitigation and Adaptation Commission
Co-Chair Ryan K. P. Kanakaʻole

Before the House Committees on
ENERGY AND ENVIRONMENTAL PROTECTION
AND
AGRICULTURE

Thursday, February 12, 2026
10:20 AM
State Capitol, Conference Room 325

In consideration of
HOUSE BILL 1617
RELATING TO TAXATION

House Bill 1617 reestablishes the Agricultural Development and Food Security Special Fund. Establishes the Carbon Emissions Tax and Dividend Special Fund. Gradually increases the Environmental Response, Energy, Carbon Emissions, and Food Security tax rates and establishes a refundable carbon cashback tax credit to offset increases for most taxpayers. The bill requires reports to the Legislature and appropriates funds. **The Hawaiʻi Climate Change Mitigation and Adaptation Commission (Commission) Supports this measure.**

The Commission consists of a multi-jurisdictional effort between 20 departments, committees, and counties with the purpose of promoting ambitious, climate-neutral, culturally responsive strategies for climate change adaptation and mitigation.

This bill proposes to initiate several measures including establishing carbon pricing to drive down use of fossil fuels while redistributing funds to offset costs. The State Climate Action Pathways (2025) modeled carbon pricing and it's impacts on the state's greenhouse gas (GHG) emissions. The table below shows the reduction of fossil fuel use and GHG emissions under a scaling carbon price, the resulting revenue generation, and the net present value (NPV) of the action in 2045.

	2028	2030	2035	2040	2045	Cumulative 2028-2045
Total emissions from fossil fuel use (MMTCO2e)	11.6	11.4	10.9	10.5	10.2	194.3
Total emissions reduced by carbon pricing (MMTCO2e)	0.4	0.6	1.2	1.7	2.1	30.4
Carbon price ($/ton)	10.00	26	68	108	150	
Annual carbon price collections ($ millions)	112.4	283.7	655.0	962.1	1,221.4	12,980
NPV (3%)						9,210

Carbon pricing measure calculation results for milestone years.

As shown in the table above a $150 per ton carbon price can drive down emissions while generating funds which can be redistributed and/or support additional GHG reduction or climate resiliency actions. This bill proposes a carbon price of nearly double that with 1 ton equal to approximately 7 barrels, which would reduce emissions even further. Climate pricing with distribution is an innovative mechanism to protect public health and assist in the transition to more resilient and affordable energy in an equitable manner.

Mahalo for the opportunity to comment on this measure.

JOSH GREEN M.D.
GOVERNOR

SYLVIA LUKE
LT. GOVERNOR

GARY S. SUGANUMA
DIRECTOR

KRISTEN M.R. SAKAMOTO
DEPUTY DIRECTOR

STATE OF HAWAIʻI
DEPARTMENT OF TAXATION
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TESTIMONY OF
GARY S. SUGANUMA, DIRECTOR OF TAXATION

TESTIMONY ON THE FOLLOWING MEASURE:
H.B. No. 1617, Relating to Taxation.

BEFORE THE:
House Committees on Energy & Environmental Protection, and Agriculture & Food Systems

DATE: Thursday, February 12, 2026
TIME: 10:20 a.m.
LOCATION: State Capitol, Conference Room 325

Chairs Lowen and Chun, Vice-Chairs Perruso and Kusch, and Members of the Committees:

The Department of Taxation (DOTAX) offers the following comments regarding H.B. 1617 for your consideration.

Agricultural Development and Food Security Special Fund

Section 2 of H.B. 1617 reinstates the "Agricultural Development and Food Security Special Fund" under Chapter 141, Hawaii Revised Statutes (HRS). The Department of Agriculture and Biosecurity is to report to the legislature prior to each regular session on the status and progress of existing and new programs and activities financed by this fund. Contributions to the fund will include deposits from the "Environmental Response, Energy, Carbon Emissions, and Food Security" tax ("barrel tax") revenues provided for under section 243.3.5, HRS.

Carbon Emissions Tax and Dividend Special Fund

Section 3 of H.B. 1617 establishes the Carbon Emissions Tax and Dividend Special Fund, which will be funded by the fuel tax. The special fund, to be administered by DOTAX, is intended to cover expenses for administration of the environmental response, energy, carbon emissions, and food security tax and the carbon cashback tax credit.

Carbon Emission Tax Credits

Section 4 of the bill establishes a fixed dollar amount carbon cashback tax credit for taxable years beginning after December 31, 2025, based on set dollar amounts for filing status, as follows:

Single or married filing separately:	$ 52
Head of Household:	$ 52
Married filing jointly, or surviving spouse:	$104
Each qualifying dependent claimed:	$ 26

For taxable years beginning after December 31, 2026, the tax credit amounts will be based on “shares,” where the value of a share is calculated as follows:

$$\frac{\text{Total revenue collected and deposited in the general fund from the barrel tax for the taxable year}}{\text{(divided by) } 1{,}440{,}000 \text{ whole shares}}$$

Credit of Shares based on filing status will be:

Single or married filing separately:	One share
Head of Household:	One share
Married filing jointly, or surviving spouse:	Two shares
Each qualifying dependent claimed:	One-half share

A taxpayer with no income tax liability may file a claim for a refund. Failure to file an original or amended return on or before the end of the twelfth month following the close of the taxable year for which the credit is allowed will result in a waiver of the right to claim the credit. Any credit not issued when the return filing deadline has passed will be allocated to the Department of Human Services (DHS) for its Med-QUEST division. DOTAX is to determine this allocation based on the following calculation:

(Number of whole shares x value of one share) – Total carbon tax credits issued
(*or a substantively similar calculation)

For purposes of administering the credit, DOTAX may revise forms to allow issuance of the credit that does not require taxpayers to proactively submit a claim, alert taxpayers of the credit, and adopt necessary rules. Also, a "qualifying taxpayer" does not include any person claimed or otherwise eligible to be claimed as a dependent for either federal or Hawaii income tax.

Barrel Tax on Carbon Emissions

Under Section 7 of the bill, section 243-3.5(a), HRS, which imposes the current $1.05 tax rate per barrel or fractional part of a barrel, is amended to include "carbon emissions" within the barrel tax, and impose new barrel tax rates on petroleum product distributors for 2026 to 2035, with a provision for increases thereafter, as follows:

$ 5.25 for 2026;	$26.25 for 2031;
$ 9.45 for 2027;	$30.45 for 2032;
$13.65 for 2028;	$34.65 for 2033;
$17.85 for 2029;	$38.95 for 2034;
$22.05 for 2030;	$43.05 for 2035.

For each taxable year after 2035, these tax rates will be increased by $1.00 for each barrel or fractional part of a barrel. The cumulative increased tax rate is effective beginning on January 1 of each calendar year.

Section 243-3.5(b) is amended to prioritize the fiscal year distributions from the new tax amounts collected, adding four new expenditures in the six through nine positions, as follows:

(6) 15 cents of the tax on each barrel into the reinstated "Agricultural Development and Food Security Special Fund;"
(7) $1,000,000 into the new "Carbon Emissions Tax and Dividend Special Fund;"
(8) All tax collected on aviation fuel into the "Airport Revenue Fund" established under section 248-8, HRS; and
(9) $1.05 for each barrel of liquid fuel sold for, or used, for "small boats" into the "Boating Special Fund" established under section 248-8, HRS (determined in accordance with the methods and definitions under that section).

Any excess revenues will be deposited into the general fund.

Barrel Tax on Fossil Fuels

Section 243-3.5(c), which imposes the current 19 cents tax rate on each one million British thermal units of fossil fuel, is amended so that in addition to the tax increases under subsection (a), the barrel tax will also be imposed with new rates on each one million British thermal units of fossil fuel sold by a distributor to any retail dealer or end user of fossil fuel, other than a refiner, as follows:

$0.79 for 2026;	$3.79 for 2031;
$1.39 for 2027;	$4.39 for 2032;
$1.99 for 2028;	$4.99 for 2033;
$2.59 for 2029;	$5.59 for 2034;
$3.19 for 2030;	$6.09 for 2035.

For each taxable year after 2035, these tax rates will be increased by 15 cents on each one million British thermal units of fossil fuel. The cumulative increased tax rate is effective beginning on January 1 of each calendar year.

Section 243-3.5(c) is amended to prioritize the fiscal year distributions from the new tax amounts collected, adding one new expenditure in the fourth position, as follows:

(4) 14.3 per cent of the tax on each one million British thermal units will be deposited into the reinstated Agricultural Development and Food Security Special Fund.

Any excess revenues will be deposited into the general fund.

Coal used to fulfill an existing power purchase agreement in place as of June 30, 2015, between an independent power producer and electric utility is exempt from the tax imposed under section 243-3.5(c), but extensions and subsequent agreements are not exempt.

Appropriations, Reporting & Effective Dates

To administer the new carbon cashback tax credit program for fiscal year 2026 to 2027, an appropriation is made under Section 9 of the bill for $1,000,000 from the general fund. Section 10 of the bill requires DOTAX to submit to the legislature a minimum of 40 days before the session start:

- of the regular session of 2027, an interim report regarding preparation status of the program; and

- before the start of each yearly regular session for 2028 through 2036 subsequent annual reports with specified information.

The measure will take effect on July 1, 2026, provided that the initial carbon cashback tax credits authorized under Section 4 of the bill apply for taxable years beginning after December 31, 2025, and the barrel tax increases under Section 7 of the bill apply for taxable years beginning after December 31, 2026.

DOTAX Comments

DOTAX notes that this is a relatively complex bill that will significantly alter existing credit calculations and revenue allocations, requiring substantial reconfiguring of work processes. Further, calculating the credit amounts based on deposits to the general fund in a given taxable year will be difficult to administer. The carbon tax is reported on the monthly fuel tax returns. If the credit is based on the same taxable year revenues, DOTAX will not have the ability to calculate the new yearly share credits until after the following year close of filing season. As such, DOTAX would not know the amount of carbon tax that will be taken in for the year, and therefore would not be able to determine the credit share amount.

Further, forms for the taxable year are prepared, amended, and finalized months before the end of the taxable year. This is prior to knowing what the carbon tax collected for the taxable year will be in order to make the required calculations.

Additionally, calculating and allocating unclaimed credits for transfer to the DHS Med-QUEST division will be administratively burdensome and difficult. The amounts needed to perform the calculation will not be available until after the close of the tax filing season, and this will require a substantial change in the way credits are issued and tracked.

DOTAX also notes that a “qualifying taxpayer” is broadly defined to include “any individual who is subject to taxes under this chapter.” This may include both part-year residents and non-residents. DOTAX recommends making the credit nonrefundable or adding a provision requiring that the credit amount for part-year residents and nonresidents be multiplied by the ratio of Hawaii adjusted gross income to federal adjusted gross income.

Also, the credit is allowable per dependent, but this term is not defined. DOTAX recommends amending the bill to include a definition of dependent for clarity and to prevent the potential for waste, fraud, or abuse.

Finally, based on the overall complexity of the bill and preparations that will be necessary to enact and administer it, DOTAX requests that Section 4 of the bill apply to taxable years beginning after December 31, 2027, section 7 be effective on January 1, 2027, and the first report to the Legislature in section 10 of the bill be extended accordingly.

Thank you for the opportunity to provide comments on this measure.

TESTIMONY OF
THE DEPARTMENT OF THE ATTORNEY GENERAL
KA ʻOIHANA O KA LOIO KUHINA
THIRTY-THIRD LEGISLATURE, 2026

ON THE FOLLOWING MEASURE:
H.B. NO. 1617, RELATING TO TAXATION.

BEFORE THE:
HOUSE COMMITTEES ON ENERGY & ENVIRONMENTAL PROTECTION AND ON AGRICULTURE & FOOD SYSTEMS

DATE: Thursday, February 12, 2026 **TIME:** 10:20 a.m.

LOCATION: State Capitol, Room 325

TESTIFIER(S): Anne E. Lopez, Attorney General, or
John E. Cole, Deputy Attorney General

Chairs Lowen and Chun and Members of the Committees:

The Department of the Attorney General provides the following comments regarding this bill.

Section 2 of this bill adds to chapter 141, Hawaii Revised Statutes (HRS), a new section to establish the Agricultural Development and Food Security Special Fund, which will be funded, in part, by a portion of the Environmental Response, Energy, Carbon Emissions, and Food Security Tax. Section 3 of this bill adds to chapter 231, HRS, a new section to establish the Carbon Emissions Tax and Dividend Special Fund. Section 4 of this bill adds to chapter 235, HRS, a new section to create a Carbon Cashback Tax Credit. Section 7 of this bill amends section 243-3.5, HRS, the Environmental Response, Energy, and Food Security Tax to include "Carbon Emissions" and to increase the amount of the tax.

Pursuant to section 37-52.3, HRS, when establishing a special fund, the Legislature must ensure that the special fund:

(1) Serves a need, as demonstrated by:
   (A) The purpose of the program to be supported by the fund;
   (B) The scope of the program, including financial information on fees to be charged, sources of projected revenue, and costs; and
   (C) An explanation of why the program cannot be implemented successfully under the general fund appropriation process;

(2) Reflects a clear nexus between the benefits sought and charges made upon the program users or beneficiaries or a clear link between the program and the sources of revenue, as opposed to serving primarily as a means to provide the program or users with an automatic means of support that is removed from the normal budget and appropriation process;
(3) Provides an appropriate means of financing for the program or activity that is used only when essential to the successful operation of the program or activity; and
(4) Demonstrates the capacity to be financially self-sustaining.

The bill does not identify a program that will be supported by the Agricultural Development and Food Security Special Fund, nor does the bill provide a purpose, scope, or an explanation as to why the program cannot be implemented successfully under the general fund appropriation process. Thus, we recommend that the bill identify the program that will be supported by the special fund and provide an explanation of the purpose and scope of the program and how the special fund is necessary for the program's implementation.

Additionally, the bill states that the moneys in the Agricultural Development and Food Security Special Fund may, in part, be expended to award grants to farmers for agricultural production or processing activities (page 3, lines 10 to 11), but provides no standards for those grants to be awarded. Article VII, section 4, of the Constitution of the State of Hawaii requires that "[n]o grant of public money or property shall be made except pursuant to standards provided by law." We suggest that grant standards be added to the bill and we have attached draft standards to this testimony as a sample to work from. These standards could be inserted in the new section 141- on page 4, line 9, of the bill as a new subsection (d), with subsequent subsections appropriately re-designated. If necessary, we are happy to work with the Committees on developing more specific standards.

Finally, article III, section 1, of the Hawaii Constitution, provides:

> The legislative power of the State shall be vested in a legislature, which shall consist of two houses, a senate and a house of representatives. Such power shall extend to all rightful subjects of legislation not inconsistent with this constitution or the Constitution of the United States.

"[A]bsent a constitutional restriction on the legislative power, one legislature cannot restrict or limit the right of a succeeding legislature to exercise the power of legislation." State ex. rel. Stenberg v. Moore, 544 N.W.2d 344, 349 (Neb. 1996).

Accordingly, the following sentence in the proposed new section 235- (f), HRS, on page 8, lines 11 to 14, would likely not bind future legislatures to appropriate amounts representing unissued carbon cashback tax credits in a manner that allocates those amounts to the Med-QUEST division:

> "Any carbon cashback tax credits not issued pursuant to this section for the most recent taxable year for which the return filing deadline has passed ***shall be allocated*** to the department of human services' Med-QUEST division." (emphasis added).

To instead establish a binding reporting standard that would make future legislatures aware of the amount of unissued carbon cashback tax credits that could be allocated to purposes, such as the Med-QUEST division, we suggest amending the first sentence of the proposed new section 235- (f), HRS, on page 8, lines 11 to 14, to read:

> (f) The department of taxation shall report annually to the legislature no later than forty days prior to the convening of each legislative session the amount of any carbon cashback tax credits not issued pursuant to this section for the most recent taxable year for which the return filing deadline has passed. . . .

We respectfully ask the Committee to consider our comments.

POSSIBLE STANDARDS FOR THE GRANTS IN THIS BILL

(d) Applications for grants shall be made to the department of business, economic development and tourism and contain the information as shall be required by rules adopted thereunder. At a minimum, the applicant shall:

(1) Be licensed or accredited, in accordance with federal, state, or county statutes, rules, or ordinances, to conduct the activities or provide the services for which a grant is awarded;

(2) Provide a detailed plan outlining the scope, objectives, and projected impact of the project or projects and a clear breakdown of how grant funds will be utilized;

(3) Agree to use state funds exclusively for the purposes of this program;

(4) Indicate capability to properly use the grant for the purpose of the grant program. [Specific applicant qualifications should be described for the different types of grants.];

(5) Comply with all applicable federal and state laws prohibiting discrimination against any person on the basis of race, color, national origin, religion, creed, sex, age, sexual orientation, disability, or any other characteristic protected under applicable federal or state law;

(6) Agree not to use state funds for purposes of entertainment or perquisites;

(7) Comply with other requirements as the department may prescribe;

(8) Comply with all applicable federal, state, and county statutes, rules, and ordinances;

(9) Agree to indemnify and save harmless the State of Hawaii and its officers, agents, and employees from and against any and all claims arising out of or resulting from activities carried out or projects undertaken with funds provided hereunder and procure

sufficient insurance to provide this indemnification if requested to do so by the department.

(10) Agree to make available to the department all records the applicant may have relating to the grant, to allow state agencies to monitor the applicant's compliance with this section.

HB-1617
Submitted on: 2/10/2026 2:45:03 PM
Testimony for EEP on 2/12/2026 10:20:00 AM

Submitted By	Organization	Testifier Position	Testify
Steve Parsons	Kauai Climate Action Coalition	Support	Written Testimony Only

Comments:

Aloha Chair Lowen and Vice Chair Perruso, and Chair Chun and Vice Chair Kusch,

I strongly support this bill because it reduces climate pollution and increases Hawai‘i’s energy independence while financially helping vulnerable kama‘aina families.

The bill places a gradually rising carbon fee on fossil fuels, incentivizing businesses and individuals to use less fossil fuels, the emissions from which are warming the Earth and creating climate havoc in Hawai‘i and globally.

The policy is budget neutral. The carbon fee revenues are used to fund a climate rebate that is distributed to Hawai‘i tax filers. The climate rebate makes the bill progressive and protects vulnerable lower-income families.

The bill is simple to administer because it relies on existing mechanisms to collect the carbon fee and distribute the climate rebates.

Hawai‘i must take a multi-pronged approach to reduce carbon emissions and lessen our dependence on fossil fuels that are subject to the price volatility of the global market while financially helping our kama‘aina make the transition. This bill helps achieve those goals efficiently and equitably, and works well with other policy approaches.

Mahalo!

Steve Parsons Lead for Kauai Climate Action Coalition Hanapepe HI

Citizens' Climate Lobby Hawaii

cclhawaii.org

February 10, 2026

STRONG SUPPORT OF HB1617 - RELATING TO TAXATION

Dear Chairs Lowen and Chun, Vice-Chairs Perruso and Kusch, and members of the Energy and Environmental Protection and Agriculture and Food Systems Committees,

Citizens' Climate Lobby (CCL) Hawaii is in STRONG SUPPORT of HB1617. CCL Hawaii has over 1,110 members across Hawaii. We are a grassroots organization advocating for effective, efficient, and fair climate legislation.

HB1617 "Reestablishes the Agricultural Development and Food Security Special Fund. Establishes the Carbon Emissions Tax and Dividend Special Fund. Gradually increases the Environmental Response, Energy, Carbon Emissions, and Food Security tax rates and establishes a refundable carbon cashback tax credit to offset increases for most taxpayers. Requires reports to the Legislature. Appropriates funds."

HB1617 is a pragmatic solution to one of the most important problems our residents face today: the high cost of living, which is directly tied to energy and fuel prices and volatility. This bill imposes a predictable, gradually increasing price on carbon pollution and returns the vast majority of the proceeds to residents through a refundable tax credit; a portion is set aside for specific energy and environmental programs.

This dividend focus matters. Our households, especially low- to moderate-income, are already financially strained. They cannot wait for long-term infrastructure projects to lower costs; they need protection now. The best available Hawaii-specific modeling shows that a carbon fee paired with an equal-share household dividend is progressive. In the University of Hawai`i Economic Research Organization's (UHERO's) modeling, the lowest-income quintile sees an average net benefit of about $900 per year after a few years of the program, and middle-income households benefit as well. **Bottomline**: Lower-income households come out ahead because they typically consume less fossil fuel, but everyone receives the same per-person rebate.

HB1617 also would reduce our dependence on imported fossil fuels and emissions by complementing direct regulation and clean energy investment. UHERO's analysis finds that by 2045, emissions are about 13% below baseline (the equivalent of taking about 400,000 gasoline-powered cars off the road), with roughly 25 million metric tons of cumulative avoided emissions from 2025 to 2045, while economic

output is only modestly lower than baseline. It also finds only a slight reduction in visitor spending in the modeled scenario. A critical Hawaii benefit is that visitors help fund the rebate while residents receive it. UHERO has estimated that visitors will contribute a substantial share of revenue over time, effectively serving as a visitor green fee that directly benefits local households.

Some environmental advocates express concern that "carbon pricing has been tried for decades and has not delivered." Some programs have indeed underperformed. However, isolating causality can be difficult in a highly complex environment, given events such as recessions, power plant retirements, and policy changes. The evidence does not support the claim that carbon pricing never reduces emissions.

A study of 1,500 climate policies implemented in 41 countries during the past 25 years found that carbon pricing was the most successful policy in developed economies. In addition, carbon pricing showed the most synergy when working with other policies. The key takeaway is what Hawaii advocates have long advocated: the policy is not a silver bullet (there really isn't one). Carbon Cashback is a foundational policy that works best when combined with other solutions, and other solutions are augmented by it.

HB1617 is written to complement other policies, not substitute for them. Local critics point to British Columbia and argue that carbon tax revenue could be diverted toward corporations. This is precisely why we should implement a transparent dividend design that provides residents with direct benefits and ensures transparent reporting.

HB1617's approach is fundamentally different from carbon offset markets or corporate "net zero" accounting. It is a simple pollution fee and a refundable credit to households. That is how we build environmental integrity AND political durability.

Finally, this is an affordability and equity bill. We have some of the highest electricity prices in the nation, and extremely low-income households face very high energy burdens. A recent state analysis reports electricity burdens well into the double digits for extremely low-income families and even higher for those below the poverty line.

HB1617 provides immediate household protection while accelerating our transition from energy dependence to energy self-sufficiency. Please pass HB1617.

Sincerely,
Citizens' Climate Lobby Hawaii
cclhawaii.org
hi.ccl.hawaii@gmail.org

Citizens' Climate Lobby (CCL) is a nonprofit, nonpartisan, grassroots advocacy organization focused on national policies to address climate change solutions. CCL Hawaii's members are part of a 268,500+ global organization. For more information, visit citizensclimatelobby.org.

CLIMATE FUTURE FORUM

Date:	February 10, 2026
To:	Representative Nicole E. Lowen, Chair Representative Amy A. Perruso, Vice Chair Members of the House Committee on Energy & Environmental Protection (EEP) Representative Cory M. Chun, Chair Representative Matthias Kusch, Vice Chair Members of the House Committee on Agriculture & Food Systems (AGR)
From:	Climate Future Forum
Re:	**SUPPORT for HB1617**
Hearing:	02/12/2026, Thursday, 10:20 AM

As a youth leader of Climate Future Forum (CFF), I thank you for the opportunity to testify in **support of HB1617**, on behalf of CFF. The Climate Future Forum empowers youth (ages 14-26) to actively engage in shaping and advocating for climate policy and legislation. This bill represents a crucial step toward meeting Hawaii's clean economy goals while ensuring the transition is equitable and economically sound.

As a 16-year-old resident, this bill is deeply personal to me because climate change is directly threatening my future and has already impacted my life. Growing up in California, I experienced firsthand how the climate crisis is making natural disasters more severe and frequent. The increasing temperatures and prolonged droughts have created dangerously dry conditions, turning chaparrals into tinderboxes. Dead vegetation accumulates while living plants lose moisture, creating perfect conditions for fires to ignite and spread rapidly. In 2021, my family had to evacuate our home due to an approaching wildfire– an experience that brought the reality of climate change into sharp focus. Now living in Hawaii, I see different but equally concerning impacts of climate change, from coral bleaching to coastal erosion. This isn't just about abstract future threats – climate change is already reshaping my life and the lives of young people everywhere. We need bold action like HB 1617 to ensure my generation has the opportunity for a stable and sustainable future.

HB1617 adjusts the environmental response, energy, and food security tax to address carbon emissions, gradually raising the tax rate over time, creates a refundable tax credit to mitigate the effect of a carbon emissions tax on lower-income taxpayers, allocates funds to the carbon

emissions tax and dividend special fund, and reenacts the agricultural development and food security fund.

The carbon cashback program established by this bill would help Hawaii reduce its dependence on imported fossil fuels and encourage a gradual shift toward cleaner energy sources, improving Hawaii's energy security and creating new opportunities for our growing clean energy sector. Research by the University of Hawaii Economic Research Organization confirms that this type of program can effectively reduce emissions while providing economic benefits to most Hawaii households. Their analysis shows this is one of the most cost-effective ways to meet our state's climate goals while protecting vulnerable residents.

This legislation is particularly noteworthy for its focus on equity and fairness. Lower-income households would receive financial support through refundable tax credits, ensuring they are protected from increased energy costs.

The bill would also strengthen Hawaii's food security by reinstating the agricultural development and food security special fund. This recognizes the crucial connection between climate action and local food production, helping to build a more resilient and sustainable Hawaii.

Hawaii has long been a leader in clean energy and climate action. This thoughtfully designed program would help maintain that leadership while ensuring the benefits are shared fairly across our communities. It represents a balanced approach to one of our most pressing challenges.

By bringing together youth, educators, policymakers, and nonprofits, the Climate Future Forum fosters meaningful dialogue on climate action priorities and provides actionable steps to address climate change in Hawai‘i. Through discussions involving over 100 youth, the forum has identified key high-priority areas, including regenerative food systems, climate and the economy, clean energy and transportation, climate justice and equity, and sustainable infrastructure.

Thank you very much for your support of youth engagement in climate policy. We respectfully urge the Committees to pass this bill.

Sincerely,
Sophia Park
Youth Leader of Hawai‘i Climate Future Forum

P.O. Box 253, Kunia, Hawai'i 96759
Phone: (808) 848-2074; Fax: (808) 848-1921
e-mail info@hfbf.org; www.hfbf.org

February 12, 2026

HEARING BEFORE THE
HOUSE COMMITTEE ON ENERGY & ENVIRONMENTAL PROTECTION
HOUSE COMMITTEE ON AGRICULTURE & FOOD SYSTEMS

TESTIMONY ON HB 1617
RELATING TO TAXATION

Conference Room 325 & Videoconference
10:20 AM

Aloha Chairs Lowen and Chun, Vice-Chairs Perruso and Kusch, and Members of the Committees:

I am Brian Miyamoto, Executive Director of the Hawaiʻi Farm Bureau (HFB). Organized since 1948, the HFB is comprised of 1,800 farm family members statewide and serves as Hawaiʻi's voice of agriculture to protect, advocate, and advance the social, economic, and educational interests of our diverse agricultural community.

The Hawaiʻi Farm Bureau provides comments on HB 1617. HFB supports the reestablishment of the Agricultural Development and Food Security Special Fund as proposed in HB 1617. The original intent of the Environmental Response, Energy, Carbon Emissions, and Food Security Tax, commonly referred to as the Barrel Tax, was to support clean energy, environmental response, and local agricultural production as part of a broader effort to reduce Hawai'i's reliance on imported fuel and food.

As an organization that generally opposes new or increased taxes, HFB took the unusual step of supporting the Barrel Tax when it was first enacted because it included a dedicated, protected funding source for agriculture. At the time, the agricultural sector faced significant and long-standing underinvestment, and the Agricultural Development and Food Security Special Fund was intended to provide stable, predictable resources to increase local food production, strengthen agricultural infrastructure, and improve food security.

When the agricultural portion of the Barrel Tax was repealed in 2021, agriculture lost a critical source of dedicated funding. While we recognize the fiscal challenges the State faced during that period, we believe the removal of the agricultural fund undermined the original balance and intent of the Barrel Tax as it was presented to, and supported by, the agricultural community.

HFB's primary interest in HB 1617 is the reinstatement of the Agricultural Development and Food Security Special Fund and restoring its original purpose. We believe that reinvesting a portion of these revenues directly into agriculture remains essential to addressing Hawai'i's food security challenges and to supporting farmers and ranchers working to increase local production.

At the same time, we respectfully note concerns regarding the broader structure of HB 1617. The bill proposes substantial, scheduled increases to the Barrel Tax through 2035, with automatic increases thereafter, and allocates the resulting revenues to an increasing number of programs and initiatives. As more purposes are attached to the Barrel Tax, pressure to increase the tax understandably grows. These increases, however, will have ripple effects across the economy, including higher fuel, transportation, and energy costs that ultimately impact farmers, ranchers, and food prices.

We urge the Committee to ensure that, at a minimum, the Agricultural Development and Food Security Special Fund is fully reinstated and protected for its intended agricultural purposes. Restoring agriculture's share honors the original intent of the Barrel Tax and recognizes the critical role local food production plays in Hawai'i's resilience, sustainability, and long-term security.

Thank you for the opportunity to provide testimony on this measure.

Aloha Chairs, Vice Chairs, & EEP/AGR Committee Members,

My name is Dave Mulinix, Co-Founder & Hawaii State Representative of Greenpeace Hawaii. On behalf of our thousands of supporters and members statewide we stand in STRONG OPPOSITION to HB1617 that Reestablishes the Agricultural Development and Food Security Special Fund. Establishes the Carbon Emissions Tax and Dividend Special Fund. Gradually increases the Environmental Response, Energy, Carbon Emissions, and Food Security tax rates and establishes a refundable carbon cashback tax credit to offset increases for most taxpayers. Requires reports to the Legislature. Appropriates funds.

We do support Reestablishing the Agricultural Development and Food Security Special Fund for farmers, but we do not support adding Carbon Cashback to this legislation. The problem with adding Carbon Cashback to legislation to Reestablish the Agricultural Development and Food Security Special Fund is that there is no proof that Carbon Cashback will be of a any substantial benefit to farmers. In fact all evidence confirms that Carbon Cashback will be a financial burden for farmers. Just last year Canada had to repeal it's carbon tax because farmers and consumers demanded it be repealed specifically because it was hurting them financially, and there was little to no evidence evidence that the carbon tax was cutting carbon emissions. Also there was significant opposition to the Carbon Cashback bill during last year's and this years sessions of the Hawaii State Legislature. Organizations that opposed Carbon Cashback last year and this year include The Grassroot Institute of Hawaii, Greenpeace Hawaii, The Hawaii Farm Bureau, Kauai Island Utility Cooperative, Maui Chamber of Commerce, Retail Merchants of Hawaii, and the Tax Foundation of Hawaii. They opposed a Carbon Cashback Tax because it will raise prices on all goods and services, and will particularly hurt financially consumers, farmers, and small businesses.

For the sake of Hawaii Farmers, Businesses, and Consumers, please do not pass HB1617.

Detailed Reports, Data, Articles, and Information On Why Carbon Cashback Is A Bad Idea For Hawaii Farmers, Consumers And Small Business.

It is important to note that carbon pricing and taxing schemes like Carbon Cashback are strongly opposed by over 100 Climate, Environment, Indigenous, and Justice Organizations including 350.org, Climate Justice Alliance, Earth Day Network, Energy Justice Network, Food & Water Watch, Foreign Policy in Focus, Greenpeace USA, Indigenous Environmental Network, Life of the Land, and the National Association for the Advancement of Colored People, just to name a few. See below: Open Letter To Citizens Climate Lobby In Regard To Concern To Carbon Fee And Dividend. [1]

Just a few of the reasons the major Climate, Environment, Indigenous, and Justice Organizations oppose carbon pricing and taxing schemes like Carbon Cashback is because in their 30 years history they have been ineffective in reducing carbon emissions; and they raise prices on all goods and services thus having a negative financial impact on farmers, small businesses, low-income families, people of color, and indigenous communities. See below Greenpeace Hawaii short 15 minute video and slide presentation explaining why a Carbon Cashback Tax will have little to no effect in cutting carbon emissions and will financially hurt low-income families. [2]

"*I will not sell or exchange my life and my health for a check. To me, that would be the same as authorizing someone to pollute me...Just to make matters simple for people who are very aggressive and want to tell me how I don't understand how this is going to benefit me. Nothing taking away my life and my health will ever benefit me, so there's no explanation that you can ever give me that will make*

me support any of this no matter what name you call it." - Kathy Egland, NAACP National Board of Directors.

See below detailed reports by the NAACP, Indigenous Environmental Network, Food & Water Watch, and Earth Justice Network on why carbon pricing and taxing schemes have not, will not, and cannot lower carbon emissions, and why farmers, small businesses, low-income families, people of color, and indigenous communities suffer the greatest hardship when they are implemented. [3]

Some key points of our concerns regarding Carbon Cashback include:

1) A Carbon Cashback Tax will make an insignificant reduction in carbon emissions. According to the UN IPCC report if we are to avoid Climate breakdown we need to lower global carbon emissions by 45% by 2030. It's important to note that Carbon Cashback Hawaii acknowledges that the Carbon Cashback Tax will only cut carbon emission by 10% over 20 years, this means projections for the CO2 reductions amount will average only half of a percent per year, which does not even come close to making a dent in what is needed.

"*What does stopping oil, coal, and gas at the source look like? It means no new drilling, no new oil and gas pipelines, and no new mining. Proposals for carbon taxes and cap-and-trade have taken up too much climate-solution oxygen in recent years, and so far they have been flimsy half measures porous with loopholes. They come nowhere close to meeting the scale of the crisis.*" - Annie Leonard, Greenpeace USA

2) Carbon Cashback is based on an unproven theory that carbon pricing and taxes can reduce carbon emissions. A peer reviewed research paper examined all 37 studies that assessed the actual effects of carbon pricing policy on emissions reductions concluded that overall, aggregate reductions from carbon pricing has a limited impact on emissions—generally between 0% and 2% per year. The author summed her finding up, stating: *"We've now had 30 years of experience on carbon pricing, and not a hell of a lot to show for it."* - Jessica Green, Professor studying Climate Change, Carbon Markets, and Fossil Fuel Companies at The University of Toronto. See below Does Carbon Pricing Reduce Emissions? A Review Of Ex-Post Analyses – Peer Reviewed Research Paper. [4]

3) Carbon Cashback will have a negative financial impact on low-income families who drive the furthest to work. Carbon Cashback Hawaii acknowledges and the UHERO report confirms that folks who drive the furthest to work will be negatively impacted financially by the Carbon Cashback Tax, but say they're a small percentage of commuters. So we checked it out and it's true according to HDOT only about 3% are super commuters, however this is over 17,000 people statewide who will be negatively impacted financially by a Carbon Cashback Tax. Three percent doesn't sound like a lot, but 17,000 people is a lot, and low-income families, who live the furthest from their work, and are already struggling to make ends meet, will be hit the hardest financially by a Carbon Cashback Tax. This fact was confirmed by Senators Fevella and Richards who opposed last years Carbon Cashback legislation SB2525 specifically because it would definitely hurt their constituents financially.

4) The Carbon Cashback rebate will only cover the cost of fossil fuels for individuals, but local businesses will not benefit from a Carbon Cashback Tax and so will have to raise their prices to cover the additional cost of the Carbon Cashback Tax. The Carbon Cashback Tax will increase overall prices on everything disadvantaging low-income families, consumers, farmers, and small businesses. This fact was confirmed by the Airlines of America, Chamber of Commerce Hawaii, Grassroot Institute of Hawaii, Greenpeace Hawaii, The Hawaii Farm Bureau, Island Plastic Bags Inc.,

Kauai Island Utility Cooperative, Retail Merchants of Hawaii, and the Tax Foundation of Hawaii who all testified in opposition to a Carbon Cashback Tax because it would raise prices on all goods and services, and will particularly hurt consumers and small businesses.

5) Carbon Cashback puts the cart before the horse and doesn't provide for the infrastructure needed for people to transition off of fossil fuels. The goal of a Carbon Cashback Tax is to raise the price on gasoline to make clean energy transportation the more affordable way to travel. However, commuters wont be able to give up their gas powered vehicles without first having the systems in place to support making the transition, like public transportation and adequate public electric vehicle charging stations. The Carbon Cashback Tax places a financial burden on residents without providing the essential infrastructure needed for our communities to transition to a low carbon economy.

6) Carbon Cashback is a tax and a fee or tax condones an activity making it legal for fossil fuel companies to continue to pollute. Where as a fine or prohibition makes the activity illegal. Putting a tax on carbon legalizes pollution and gives the fossil fuel industry a way to pay a tax and yet continue to expand production of planet killing fossil fuels.

We doubt very much that anyone in Hawaii would think that we should be dealing with the Red Hill fuel leak crisis or PFAS in our drinking water by putting a price on a gallon of jet fuel or PFAS in our drinking water and then use that money to try to fix our water infrastructure in the years to come.

7) Citizen Climate Lobby, the national organization that promotes carbon pricing and taxing schemes like Carbon Cashback is very selective in the reports and data that they share, and they neglect to share reports and data that undermine or refute their claims. For instance Citizen Climate Lobby's flagship of supposed carbon tax success is Canada's carbon tax that has actually turned out to be a complete failure. In response to consumers and farmers anger over the overall increase in prices on all goods and services the Canadian Parliament has essentially rescinded it's carbon tax program. .

See below multiple reports on the failure of Canada's carbon tax and articles documenting growing opposition and demand to repeal Canada's carbon tax. [5]

Mahalo
Dave Mulinix, CoFounder & Hawaii State Representative
Greenpeace Hawaii

References:

[1] Open Letter To Citizens Climate Lobby In Regard To Concern To Carbon Fee And Dividend - Energy Justice Network. http://www.energyjustice.net/files/climate/CCLsignon.pdf

[2] Link to Greenpeace short 15 minute presentation on why Carbon Cashback will have little effect on cutting carbon emissions and will financially hurt low-income families.
https://drive.google.com/file/d/1KMmDrRHE_pfT8yCIXfAYi5R1ob_u9NDY/view

[3] Detailed reports by the NAACP, Indigenous Environmental Network, Food & Water Watch, and Earth Justice Network on why carbon pricing and taxing schemes have not, will not, and cannot lower carbon emissions, and why low-income families, people of color, and indigenous communities suffer the greatest hardship when they are implemented.

National Association for the Advancement of Colored People (NAACP) Report
Nuts Bolts And Pitfalls Carbon Pricing Equity Based Primer Paying Pollute
Why Carbon Pricing and Trading Is a False Solution
https://naacp.org/resources/nuts-bolts-and-pitfalls-carbon-pricing-equity-based-primer-paying-pollute

Indigenous Environmental Network
Carbon Pricing is a False Solution to Climate Chaos
Just before the United Nations' Climate Change Conference (COP26) Indigenous Environmental Network partnered with Diné artist Liv Barney on this short animation to break down carbon pricing schemes building on our previous work with our Carbon Pricing Toolkit and Hoodwinked in the Hothouse.
https://www.youtube.com/watch?v=qztBrTwm2jU

Climate Justice Alliance and Indigenous Environmental Network Report
Carbon Pricing A Critical Perspective for Community Resistance
https://www.ienearth.org/wp-content/uploads/2017/11/Carbon-Pricing-A-Critical-Perspective-for-Community-Resistance-Online-Version.pdf

Food & Water Watch Report
Off Course: Carbon Pricing Myths and Dirty Truths
https://www.foodandwaterwatch.org/wp-content/uploads/2021/06/IB_2106_AgCarbonOffsets-WEB-1.pdf

Energy Justice Network Report
Are Carbon Taxes Another False Solution?
https://energyjustice.net/are-carbon-taxes-another-false-solution/

[4] Does Carbon Pricing Reduce Emissions? A Review Of Ex-Post Analyses - Research paper by Jessica Green, Professor studying Climate Change, Carbon Markets, & Fossil Fuel Companies at The University of Toronto. https://iopscience.iop.org/article/10.1088/1748-9326/abdae9

[5] Multiple reports on the failure of Canada's carbon tax and articles documenting growing opposition and demand to repeal Canada's carbon tax.

Government of Canada
Removing the consumer carbon price, effective April 1, 2025
https://www.canada.ca/en/department-finance/news/2025/03/removing-the-consumer-carbon-price-effective-april-1-2025.html

AgEcon Search: Research in Agricultural and Applied Economics Report
The Impact of Carbon Tax on Food Prices and Consumption in Canada
https://ageconsearch.umn.edu/record/275913?ln=en&v=pdf

Food & Water Watch Report
The British Columbia Carbon Tax. A Failed Experiment in Market-Based Solutions to Climate Change
https://www.foodandwaterwatch.org/wp-content/uploads/2021/09/rpt_1609_carbontax_web17011.pdf

Why agricultural groups fiercely oppose the carbon tax
https://news.usask.ca/articles/research/2019/why-agricultural-groups-fiercely-oppose-the-carbon-tax.php#:~:text=Farmers%20produce%20a%20homogeneous%20product,on%20in%20the%20supply%20chain.

Ontario Federation of Agriculture
Cancellation of Carbon Tax
https://ofa.on.ca/cancellation-of-carbon-tax/#:~:text=OFA%20had%20long%20urged%20the,and%20support%20sustainable%20agricultural%20production.

Canada gasoline prices slide on removal of consumer carbon tax
https://www.reuters.com/world/americas/canada-gasoline-prices-slide-removal-consumer-carbon-tax-2025-04-02/

FEBRUARY 12, 2026

HOUSE BILL 1617

CURRENT REFERRAL: EEP/AGR

808-679-7454
kris@imuaalliance.org
www.imuaalliance.org
@imuaalliance

POSITION: SUPPORT

Imua Alliance supports HB 1617, relating to taxation, which reestablishes the Agricultural Development and Food Security Special Fund; establishes the Carbon Emissions Tax and Dividend Special Fund; gradually increases the Environmental Response, Energy, Carbon Emissions, and Food Security tax rates and establishes a refundable carbon cashback tax credit to offset increases for most taxpayers.

Imua Alliance is a Hawai‘i-based organization dedicated to ending gender violence and sexual exploitation, and connecting human rights with climate justice. We appreciate this measure, which establishes meaningful carbon-pricing to reduce emissions, while returning benefits to residents through a refundable “carbon cashback” tax credit and supporting energy and food security investments.

A revenue-neutral carbon tax would act like a regular tax, except that all proceeds would be returned to taxpayers. The carbon tax would increase the price of carbon-intensive goods and services, automatically shifting the behavior of consumers and producers alike.

Hawai‘i’s emissions profile makes carbon pricing especially urgent. According to the Hawai‘i Department of Health Clean Air Branch’s 2022 Greenhouse Gas Emissions Report (summary of key results), transportation accounted for 49.8% of statewide greenhouse gas emissions, with stationary combustion another 36.6%, meaning the bulk of Hawai‘i’s climate pollution is driven by fossil fuels used for movement and energy. This bill targets these sources directly by increasing the per-barrel tax on petroleum products over time and increasing the fossil-fuel tax per million BTU, creating predictable incentives to reduce pollution and accelerate cleaner alternatives.

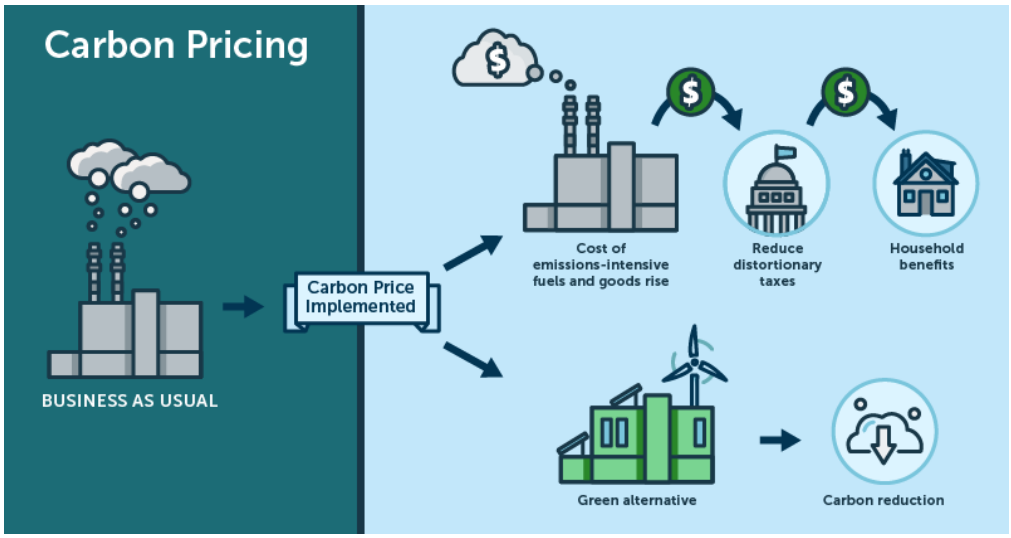
Leading climate and economic authorities recognize carbon taxes as among the most effective, efficient climate tools, especially when paired with equity protections. The IPCC finds that economic instruments have been effective in reducing emissions, and that where implemented, carbon pricing has

incentivized low-cost emissions reductions. The IPCC also emphasizes that equity and distributional impacts can be addressed by using revenue from carbon taxes to support low-income households, a core design feature of this measure's refundable credit. The International Monetary Fund likewise states that carbon taxes are among the most powerful and efficient tools governments possess to cut emissions.

This measure is aligned with global best practices: price pollution and return the value to vulnerable people. In helping protect households from regressive cost burdens while preserving the emissions-reducing impact of the fee, this idea is consistent with the IPCC's findings that "revenue recycling" can reduce overall mitigation costs and improve policy feasibility.

Carbon pricing is widely recommended to drive decarbonization. The UN-backed High-Level Commission on Carbon Prices (co-chaired by economists Joseph Stiglitz and Nicholas Stern) concluded that meeting Paris Agreement-aligned goals requires carbon prices on the order of $50–$100 per ton of CO_2 by 2030 (in a supportive policy environment).

This proposal moves Hawai'i toward predictable, scheduled carbon pricing increases, providing the long-term certainty households and businesses need to invest in a clean economy and a carbon-neutral future.



With aloha,

Kris Coffield

President, Imua Alliance

Carbon Cashback

February 10, 2026

Re: EEP/AGR hearing of HB1617 on February 12, 2026

Position: Support

Aloha Chair Lowen and Vice Chair Perruso, Committee on Energy & Environmental Protection, and Chair Chun and Vice Chair Kusch, Committee on Agriculture & Food Systems,

Carbon Cashback Hawai'i advocates for legislation that reduces carbon emissions and strengthens Hawai'i's energy independence while protecting vulnerable kama'aiana families.

Carbon Cashback Hawai'i strongly supports **HB1617,** which establishes an effective, equitable, and fiscally responsible policy that reduces greenhouse gas emissions while helping protect Hawai'i's families from rising living costs.

Carbon pricing is one of the most powerful mechanisms available for cutting fossil fuel pollution. According to the World Bank, "Carbon pricing is widely recognized as an important tool to incentivize low-carbon economic growth."

There are different forms of carbon pricing, and 55 countries have adopted carbon pricing policies in one form or another, including Germany, Belgium, Austria, Italy, South Korea, Indonesia, Australia, Argentina, Chile, and Japan. Global experiences demonstrate that carbon pricing delivers meaningful emissions reductions while supporting economic growth and innovation.

The State of Hawai'i currently relies on refundable tax credits to provide essential financial support to residents, particularly low-income households. Programs such as the Food/Excise Tax Credit, Earned Income Tax Credit, Low-Income Household Renters Tax Credit, and the Hawai'i Child Tax Credit provide crucial relief in the state with the highest cost of living in the nation. Unlike non-refundable credits, refundable credits are available to households even when no income tax is owed so that financial assistance can reach the intended populations.

This bill is innovative, combining carbon pricing with refundable tax credits to ensure that climate action does not aggravate economic hardship. It applies a gradually increasing carbon price using Hawai‘i’s existing Environmental Response, Energy, and Food Security Tax, which is assessed upstream on fossil fuel distributors. Revenues are distributed directly to residents through a refundable tax credit. Each adult is eligible for a full share, and each dependent is eligible for a half share.

This policy is budget neutral; it funds itself. The University of Hawai‘i study commissioned by the Legislature suggests that it will reduce greenhouse gas emissions by more than 13% while delivering a net financial gain to most households; that is, for most families, the refundable tax credit they receive will be more than the higher prices they pay as a result of the carbon price. Importantly, low-income families will receive the largest net gains, helping them better cope with the high cost of living.

This bill supports Hawai‘i’s statutory climate and energy goals, reduces reliance on imported fossil fuels, and supports families financially, especially low-income households.

For the foregoing reasons, Carbon Cashback Hawai‘i urges the Committee to pass this bill.

We noticed one drafting error in the bill and recommend the following correction. The increase in the barrel tax should first take place in 2027; therefore, the years for the respective barrel tax rates on both petroleum and other fossil fuels should be advanced by one year. For example, the tax rate for petroleum products and other fossil fuels in calendar year 2027 should be $5.25/barrel and $0.79/million British thermal units, respectively. Also, the tax rate in 2026 should remain at the current rate of $1.05/barrel and $0.19/million British thermal units for petroleum products and other fossil fuels, respectively.

Mahalo nui loa.

Kauaʻi Island Utility Cooperative
Your Touchstone Energy® Cooperative

Testimony Before the House Joint Committees on Energy & Environmental Protection and Agriculture & Food Systems

By Beth Amaro
Member Services and Communications Manager
Kauaʻi Island Utility Cooperative
4463 Paheʻe Street, Suite 1, Līhuʻe, Hawaiʻi, 96766-2000

Thursday, February 12, 2026; 10:20 pm
Conference Room #325 & Videoconference

House Bill No. 1617 – RELATING TO TAXATION

To the Honorable Chairs Nicole E. Lowen and Cory M. Chun, Vice Chairs Amy A. Perruso and Matthias Kusch, and Members of the Committees:

Kauaʻi Island Utility Cooperative (KIUC) is a not-for-profit utility providing electrical service to more than 34,000 commercial and residential members.

KIUC opposes this measure as it relates to a proposed carbon emissions tax.

Over the past 10 years, KIUC has significantly increased its renewable generation. In 2010, KIUC's energy mix included 10% renewable. Over the past five years, renewable production on Kauaʻi has averaged between 50% and 70%. We estimate for 2025 we achieved roughly 50% renewable, which is well-ahead of the current state Renewable Portfolio Standards (RPS) requirement of 30%.

This means we are still using significant amounts of fossil fuel, and anticipate that usage will remain relatively stable until at least 2029 when new proposed renewable projects come on line and we could potentially reach 80% renewable. Should we not be successful in deploying those projects, our fossil fuel usage will likely continue at roughly 50% of generation for the foreseeable future.

We estimate that, between 2026 and 2028 at the current consumption of fossil fuel, the additional cost of these proposed tax increases will be roughly $4 million per year, which will be passed directly to ratepayers at a cost of approximately $4 per month.

KIUC has met and exceeded all benchmarks associated with the state's RPS and has set its own strategic goal of reaching 100 percent renewable by 2033: 12 years ahead of the state mandate. We believe SB 2332 does not acknowledge these efforts, would penalize electric utilities who are in compliance with the RPS, and would adversely impact KIUC's members (ratepayers). If this bill moves forward, we believe electric utilities subject to the RPS should be exempted.

Mahalo for the opportunity to comment.

HB-1617
Submitted on: 2/11/2026 9:07:11 AM
Testimony for EEP on 2/12/2026 10:20:00 AM

Submitted By	Organization	Testifier Position	Testify
Jeannette Gurung	Women Organizing for Change in Agriculture and Natural Resource Management (WOCAN)	Support	Written Testimony Only

Comments:

Aloha Chair Lowen and Vice Chair Perruso, Committee on Energy & Environmental Protection, and Chair Chun and Vice Chair Kusch, Committee on Agriculture & Food Systems,

I strongly support this bill because it reduces climate pollution and increases Hawai‘i’s energy independence while financially helping vulnerable kama‘aina families. The bill places a gradually rising carbon fee on fossil fuels, incentivizing businesses and individuals to use less fossil fuels.

My organization, WOCAN, is very much engaged in global carbon markets and sees them as a way to use policies and markets to provide capital and incentives for climate action for both mitigation and adaptation/resilience efforts. I would love to see Hawai’i play a leadership role nationally and globally by passing this bill.

The policy is budget neutral. The carbon fee revenues are used to fund a climate rebate that is distributed to Hawai‘i tax filers. The climate rebate makes the bill progressive and protects vulnerable lower-income families while also providing a new way to provide cashback benefits to lower income households, and farmers practicing climate smart agriculture.

The bill is simple to administer because it relies on existing mechanisms to collect the carbon fee and distribute the climate rebates.

Hawai‘i must take a multi-pronged approach to reduce carbon emissions and lessen our dependence on fossil fuels that are subject to the price volatility of the global market while financially helping our kama‘aina make the transition. This bill helps achieve those goals efficiently and equitably, and works well with other policy approaches.

Mahalo.

Dr. Jeannette Gurung

Executive Director, WOCAN

Kailua Kona

GRASSROOT INSTITUTE OF HAWAII

1050 Bishop St. #508
Honolulu, HI 96813
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Removing barriers to Hawaii's prosperity

Feb. 12, 2026, 10:20 a.m.
Hawaii State Capitol
Conference Room 325 and Videoconference

To: House Committee on Energy & Environmental Protection
Rep. Nicole E. Lowen, Chair
Rep. Amy A. Perruso, Vice Chair

House Committee on Agriculture & Food Systems
Rep. Cory M. Chun, Chair
Rep. Matthias Kusch, Vice Chair

From: Grassroot Institute of Hawaii
Ted Kefalas, Director of Strategic Campaigns

TESTIMONY IN OPPOSITION TO HB1617 — RELATING TO TAXATION

Aloha chair, vice chair, and other committee members,

The Grassroot Institute of Hawaii is **deeply concerned** about the potential effects of HB1617. Although presented as a "carbon tax" or "carbon emissions tax," this bill would functionally be a massive increase in the rate of taxation on petroleum and fossil fuels accompanied by a "carbon cashback" tax credit.

The tax credit provision of this bill is intended to help offset some of the economic harm it would inflict, but research by economists affiliated with the Economic Research Organization at the University of Hawai'i suggests a carbon tax of this type would cause "a reduction of total economic output of 0.6% in 2045 relative to the baseline and the contraction reduces the demand for imports."[1]

The economists projected that under a taxation scheme like the one proposed in this bill, "non-tourism exports [would] experience the largest relative impact with a decline of almost 5% in 2025 and 5.7% in 2045. The disproportionate impact occurs because prices of export goods rise relative to the price of goods produced

[1] Makena Coffman, Paul Bernstein, Maja Schjervheim, Sumner La Croix and Sherilyn Hayashida, "Economic and GHG impacts of a US state-level carbon tax: the case of Hawai'i," Climate Policy, Vol. 2, No. 7, 2022, p. 941.

outside of Hawai‘i, causing a loss of competitiveness for Hawai‘i’s non-tourism exports, such as cut flowers and other agricultural products.”

Supporters of a carbon tax rely heavily on optimistic best-case scenarios for the implementation of a program of this type. But it would be irresponsible to blindly accept the best case scenario without considering the harmful effect this bill would have on the economy as a whole.

The tax increases proposed in this bill are substantial, as they would quintuple the current rate of $1.05 per barrel to $5.25 in 2026, raise it by 80% to $9.45 in 2027, and have it reach $43.05 per barrel by 2035. What’s more, this would effectively be an infinite tax hike, as it is proposed to continue increasing by $1 every year after 2035. The bill also would skyrocket taxes on energy from fossil fuel from the current $0.19 per million BTUs to $6.09 by 2035, with another infinite tax hike scheme to follow.

The cashback proposal outlined in this bill appears to be based on the idea that it is possible to reimburse Hawaii residents for the economic impact of a massive tax hike — as though taxes were simply a question of money-in, money-out, with the state government operating as a type of bank. However, such an approach deeply underestimates the impacts that tax hikes, especially energy tax increases, can have on the economy as a whole.

Higher fuel taxes definitely would make it harder for businesses to survive, which could discourage business investment and rebound on Hawaii employment. Many Hawaii companies are still struggling from the effects of the COVID-era economic downturn and the recent inflationary environment.

Hawaii’s residents and businesses cannot afford new taxes, tax increases, fees or surcharges. A massive increase in the tax rates for fossil fuels and petroleum products will contribute to the high cost of living, especially the state’s high energy and gas prices. The far-reaching effects of this bill cannot be effectively mitigated by a rebate and would serve only to drive more residents out of our state.

Thank you for the opportunity to testify.

Ted Kefalas
Director of Strategic Campaigns
Grassroot Institute of Hawaii

The Nature Conservancy
Hawai'i and Palmyra

The Nature Conservancy, Hawai'i and Palmyra
923 Nu'uanu Avenue
Honolulu, Hawai'i 96817

Tel (808) 537-4508
nature.org/HawaiiPalmyra
hawaii@tnc.org

Testimony of The Nature Conservancy
Supporting HB1617, Relating to Taxation
Committee on Energy & Environmental Protection
Committee on Agriculture & Food Systems
February 12, 2026 at 10:20 am
Conference Room 325 and via Videoconference

Dear Chairs Lowen and Chun, Vice Chairs Perruso and Kusch, and Members of the Committee:

Mahalo for the opportunity to testify today. The Nature Conservancy (TNC) Hawai'i and Palmyra supports HB1617, which reestablishes the Agricultural Development and Food Security Special Fund, establishes the Carbon Emissions Tax and Dividend Special Fund, gradually increases the Environmental Response, Energy, Carbon Emissions, and Food Security tax rates, and establishes a refundable carbon cashback tax credit to offset increases for most taxpayers.

TNC supports putting a price on carbon pollution to make a significant contribution to addressing the challenge of climate change. Economists overwhelmingly agree that the market-based approach embodied in the legislation will achieve emissions reductions in the most efficient and lowest cost way possible. The economic impacts on families and individuals of the carbon price would be mitigated by the refundable income tax credit.

TNC works to protect and manage the natural systems that sequester carbon, provide our fresh water, and protect our coastlines; all of which reduce the impacts of climate change. However, to fully address the growing impacts of our changing climate, we need bold action. Nature can play a huge role in pulling carbon out of the atmosphere, but it needs policies like a carbon price to also ensure that emissions are reduced. HB1617 is an important step toward aligning Hawai'i's climate policy with the scale of the challenge.

Mahalo for the opportunity to testify in support of HB1617.

Guided by science, TNC is a non-profit organization dedicated to the preservation of the lands and waters upon which all life depends. The Conservancy has helped protect more than 200,000 acres of natural lands in Hawai'i and Palmyra Atoll. We manage 84,000 acres in 13 nature preserves and 18 managed areas and have supported over 50 coastal communities to help protect and restore the nearshore reefs and fisheries of the main Hawaiian Islands.

HB-1617
Submitted on: 2/11/2026 10:35:09 AM
Testimony for EEP on 2/12/2026 10:20:00 AM

Submitted By	Organization	Testifier Position	Testify
Ted Bohlen	Climate Protectors Hawai‘i	Support	Written Testimony Only

Comments:

STRONG SUPPORT!

LEGISLATIVE TAX BILL SERVICE

TAX FOUNDATION OF HAWAII

735 Bishop Street, Suite 417 Honolulu, Hawaii 96813 Tel. 536-4587

SUBJECT: INCOME, FUEL, Adoption of Carbon Tax, Income Tax Credit for Low Income Ratepayers

BILL NUMBER: HB1617; SB 2332

INTRODUCED BY: HB by ILAGAN, CHUN, EVSLIN, GRANDINETTI, HUSSEY, KAPELA, MARTEN, MORIKAWA, PERRUSO, POEPOE, TARNAS, WOODSON, Amato, Belatti, Garrett, Kila, Lowen, Miyake, Reyes Oda; SB by GABBARD, KEOHOKALOLE, RICHARDS

EXECUTIVE SUMMARY: Reestablishes the Agricultural Development and Food Security Special Fund. Establishes the Carbon Emissions Tax and Dividend Special Fund. Gradually increases the Environmental Response, Energy, Carbon Emissions, and Food Security tax rates and establishes a refundable carbon cashback tax credit to offset increases for most taxpayers. Requires reports to the Legislature. Appropriates funds.

SYNOPSIS: Adds a new section to chapter 141, HRS, to establish an agricultural development and food security special fund. The fund would receive a portion of the carbon tax, and could be expended by the Department of Agriculture, subject to legislative appropriation, for:

(1) The awarding of grants to farmers for agricultural production or processing activity;

(2) The acquisition of real property for agricultural production or processing activity;

(3) The improvement of real property, irrigation systems, and transportation networks necessary to promote agricultural production or processing activity;

(4) The purchase of equipment necessary for agricultural production or processing activity;

(5) The conduct of research on and testing of agricultural products and markets;

(6) The funding of agricultural inspector positions within the department of agriculture;

(7) The promotion and marketing of agricultural products grown or raised in the State; and

(8) Any other activity that is intended to increase agricultural production or processing and that may lead to reduced importation of food, fodder, or feed from outside the State.

Adds a new section to chapter 231, HRS, to establish a carbon emissions tax and dividend special fund. The fund is to be administered by the Department of Taxation and shall be expended for salaries, contracted services, supplies, and other administrative expenses to:

(1) Administer the environmental response, energy, carbon emissions, and food security tax;

(2) Administer the refundable tax credits established by this bill; and

(3) Increase public awareness and interest in the refundable tax credits established by this bill.

Adds a new section to chapter 235, HRS, granting a carbon cashback refundable tax credit.

For year 2026:	
Filing Status	**Credit Amount**
Single or Married Filing Separately	$ 52
Head of Household	52
Married Filing Jointly or Surviving Spouse	104
Add: Per Dependent	26
For year 2027 and thereafter:	
Filing Status	**Credit Shares**
Single or Married Filing Separately	1.0
Head of Household	1.0
Married Filing Jointly or Surviving Spouse	2.0
Add: Per Dependent	0.5

Each credit share equals the amount of barrel tax collected divided by 1,440,000.

Defines a "qualifying taxpayer" as a taxpayer who is subject to individual income tax, but does not include any person who is claimed or is otherwise eligible to be claimed as a dependent by another taxpayer for federal or Hawaii state individual income tax purposes.

Provides that any carbon cashback tax credits not issued pursuant to this section for the most recent taxable year for which the return filing deadline has passed shall be allocated to the department of human services' Med-QUEST division.

Amends section 243-3.5, HRS, to rename the barrel tax the “environmental response, energy, carbon emissions, and food security tax.” Raises the tax from $1.05 on each barrel or fractional part of a barrel of petroleum product to the following:

Calendar Year	Amount Per Barrel
2026	$ 5.25
2027	9.45
2028	13.65

2029	17.85
2030	22.05
2031	26.25
2032	30.45
2033	34.65
2034	38.65
2035	43.05
For each year thereafter add	1.00

Adds the following earmarks of barrel tax on petroleum products (per fiscal year):

(1) 15 cents per barrel to the agricultural development and food security special fund created by the bill;
(2) $1,000,000 to the carbon emissions tax and dividend special fund created by the bill;
(3) All taxes paid on gasoline or other aviation fuel sold for use in or used for airplanes shall be deposited in the airport revenue fund; and
(4) $1.05 per barrel on gasoline, diesel, or other fuel sold for use in or used for small boats shall be deposited in the boating special fund.

For non-petroleum fossil fuels, the tax per one million BTU is increased from 19 cents to:

Calendar Year	Amount Per Million BTU
2026	$ 0.79
2027	1.39
2028	1.99
2029	2.59
2030	3.19
2031	3.79
2032	4.39
2033	4.99
2034	5.59
2035	6.09
For each year thereafter add	0.15

Adds the following earmark of barrel tax on non-petroleum fossil fuels (per fiscal year):

(1) 14.3% to the agricultural development and food security special fund created by the bill.

Provides that any grandfather protection given to power purchase contracts in existence upon approval of the bill is lost when the contracts are extended or replaced.

Makes technical and conforming amendments.

EFFECTIVE DATE: July 1, 2026, provided that Section 4 (tax credit) shall apply to taxable years beginning after December 31, 2025; Section 7 (barrel tax) shall apply to taxable years beginning after December 31, 2026.

STAFF COMMENTS: **Carbon Tax Generally:** An economist from UHERO, the University of Hawaii Economic Research Organization, posted an analysis arguing that strong, decisive action such as a carbon tax is going to be needed if we are going to achieve the greenhouse gas goals. "But without any specifics as to how we are to achieve [greenhouse gas] reductions – through a carbon tax or otherwise – it is largely symbolic," she argues.

So what is a carbon tax? It is a tax imposed on the carbon content of different fuels. Typically, it is due and payable when the fuel is either extracted and placed into commerce, or when it is imported. At present, neither the U.S. federal government nor any U.S. state has enacted a carbon tax. The city of Boulder, Colorado, enacted one by referendum in 2006; it applies at the rate of $7 per metric ton of CO_2 and is imposed on electricity generation only. Several European Union countries, Japan, and South Africa have carbon taxes.

Presently, we have a liquid fuel tax (chapter 243, HRS). Like a carbon tax, the fuel tax is imposed upon import and entry into commerce. So, PFM Group, the consultant employed by the Hawaii Tax Review Commission, in its final report thought that the systems and processes we now have in place to collect fuel tax in Hawaii can be adapted to a carbon tax, and for that reason concluded that a carbon tax would entail "[l]little administrative burden." There are, however, several important differences between the two.

Both the county and state governments are given the power to impose fuel tax. This bill does not repeal the state fuel tax and does not affect the counties' power to impose fuel tax. Rather, the carbon tax is to replace the barrel tax which is now imposed at $1.05 per barrel of imported petroleum product and on other fossil fuels based on BTU equivalent.

The potential big losers will be the electric companies, because electric generation accounted for 6.8 million metric tons of CO_2 that Hawaii produced in 2013 out of a total 18.3 million metric tons. However, the electric companies won't simply absorb the tax, but can be expected to pass on the enhanced costs to anyone who gets an electric bill.

Maybe it's good for lawmakers to worry about the end of the world as we know it, which perhaps will be staved off by the social change the tax encourages. But their constituents are worried not about the end of the world, but the end of next week. Will their paychecks be enough to pay the rent, keep the lights on, or feed the family? If the cost of simply driving to work from the suburbs is horrible now, just wait until the tax kicks in.

And if you think the hammer of a carbon tax will fall most heavily on huge, faceless corporations like the electric company, the airlines, or the shippers, think again. Businesses can and will pass on any enhanced costs to their consumers if they hope to continue providing their products or services. That means our already astronomical cost of living could head further up into the stratosphere.

Different Sources of Carbon Emissions: Different fuels emit different amounts of carbon when burned. However, the tax rates in this bill do not differentiate between types of fuels burned.

Applicability of Tax to Aviation Fuel: There is an issue as to whether this tax as applied to aviation fuel would be preempted by federal law. The federal Anti-Head Tax Act, 49 U.S.C. § 40116, prohibits any tax, fee, or charge first taking effect after 1994 exclusively upon a business located at an airport unless the tax, fee, or charge is wholly utilized for airport or aeronautical purposes. 49 U.S.C. § 40116(d)(2)(A)(iv). Although the bill states that tax collected on aviation fuel is paid to the airport fund, there is an issue as to whether the carbon cashback credit, which is based on all barrel tax collections on petroleum products, would be considered a use of the tax that is unrelated to airport purposes. In addition, the barrel tax collections on non-petroleum fossil fuels used for aviation, if such fuels exist now or later, would not be paid to the airport fund and thus would violate the prohibition to that extent. These would be questions of federal, not state, law.

Allocation of Unclaimed Credits to Med-QUEST: The bill attempts to give any unclaimed credits to the Med-QUEST division of the Department of Human Services, and states that any credits not issued once the return filing deadline has passed can go to Med-QUEST. There is a technical problem because taxpayers can claim the credit on or before the end of the twelve-month period starting with the end of the tax year in which the taxpayer could first claim the credit. To fix this problem, the two dates should be aligned.

Digested: 1/31/2026

HB-1617
Submitted on: 2/10/2026 10:15:02 AM
Testimony for EEP on 2/12/2026 10:20:00 AM

Submitted By	Organization	Testifier Position	Testify
Douglas Hagan	Individual	Support	Remotely Via Zoom

Comments:

Chair Lowen, Vice Chair Chun and members of the Committee,

I support this bill.

In the name of generational legacy - for our children and grandchildren - I urge you to take bold action now and lead this great state to emission reductions of fourteen percent or more.

Carbon Cashback a Carbon Fee and Dividend approach is a proven, measurable, effective and efficient market driven approach to reducing Green House Gas (GHG) emission whilst benefiting lower income households.

UHERO has confirmed the emissions reduction and progressive nature of a policy like Carbon Cashback. It was the top recommendation of the Hawai‘i 2020-2022 Tax Review Commission. More recently, the Hawaii State Energy Office recommended a carbon surcharge using the existing barrel tax and distributing the revenue to residents.

Carbon pricing support is growing globally. Over 73 governments have introduced carbon pricing. The policy has been endorsed by economists, scientists, government and religious leaders, business chamber groups, and climate advocacy organizations.

Sweden, Canada, the EU, and other governments have deployed carbon pricing strategies and have seen positive benefits from the policy. Sweden, for instance, started pricing carbon pollution in 1991. In the first ten years, its emissions were reduced by 25% while its economy grew by over 60%.

Doug Hagan Paia, HI

HB-1617
Submitted on: 2/10/2026 10:25:01 AM
Testimony for EEP on 2/12/2026 10:20:00 AM

Submitted By	Organization	Testifier Position	Testify
Virginia Tincher	Individual	Support	Written Testimony Only

Comments:

Aloha Chair Lowen and Vice Chair Perruso, Committee on Energy & Environmental Protection and Chair Chun and Vice Chair Kusch, Committee on Agriculture and Food Systems,

I strongly support this bill because it reduces climate pollution and increases Hawai‘i’s energy independence while financially helping vulnerable kama‘aina families.

Hawai‘i must take a multi-pronged approach to reduce carbon emissions and lessen our dependence on fossil fuels that are subject to the price volatility of the global market while financially helping our kama‘aina make the transition. This bill helps achieve those goals efficiently and equitably, and works well with other policy approaches.

Mahalo!

Virginia Tincher

Honolulu

HB-1617
Submitted on: 2/10/2026 11:18:17 AM
Testimony for EEP on 2/12/2026 10:20:00 AM

Submitted By	Organization	Testifier Position	Testify
Christine Daleiden	Individual	Support	Written Testimony Only

Comments:

Aloha Chair Lowen and Vice Chair Perruso, Committee on Energy & Environmental Protection, and Chair Chun and Vice Chair Kusch, Committee on Agriculture & Food Systems,

I strongly support this bill because it reduces climate pollution and increases Hawai‘i’s energy independence while financially helping vulnerable kama‘aina families.

The bill places a gradually rising carbon fee on fossil fuels, incentivizing businesses and individuals to use less fossil fuels, the emissions from which are warming the Earth and creating climate havoc in Hawai‘i and globally.

The policy is budget neutral. The carbon fee revenues are used to fund a climate rebate that is distributed to Hawai‘i tax filers. The climate rebate makes the bill progressive and protects vulnerable lower-income families.

The bill is simple to administer because it relies on existing mechanisms to collect the carbon fee and distribute the climate rebates.

Hawai‘i must take a multi-pronged approach to reduce carbon emissions and lessen our dependence on fossil fuels that are subject to the price volatility of the global market while financially helping our kama‘aina make the transition. This bill helps achieve those goals efficiently and equitably, and works well with other policy approaches.

Christine Daleiden

HB-1617
Submitted on: 2/10/2026 11:24:43 AM
Testimony for EEP on 2/12/2026 10:20:00 AM

Submitted By	Organization	Testifier Position	Testify
William Caron	Individual	Support	Written Testimony Only

Comments:

Aloha Chairs, Vice Chairs, and members of the committees,

I am testifying in strong support of HB1617, which establishes a carbon cashback program. This is a landmark, equitable, and effective policy that directly tackles our climate crisis while putting money back into the pockets of Hawai‘i’s families, particularly those most vulnerable to rising costs.

This bill implements a straightforward, gradually rising fee on fossil fuels, creating a powerful market signal for businesses and individuals to transition toward clean energy. The revenue is not kept by the government; it is returned directly to Hawai‘i residents as a quarterly climate rebate.

This "cashback" design makes the policy both economically progressive and politically fair. Lower- and middle-income households, which typically have a smaller carbon footprint, will receive more in rebates than they pay in added costs, financially benefiting from the transition.

The program is simple to administer, leveraging existing tax and fuel distribution systems. Crucially, it is designed to protect families from day one: rebates begin in the 2025 tax year, **before** the carbon fee starts in 2026. This upfront support provides a financial cushion as the fee starts low and increases predictably.

The need for this multi-pronged approach is urgent. Hawai‘i remains dangerously dependent on volatile, imported fossil fuels. HB1617 is a powerful tool to achieve our statutory emission reduction goals, complementing other vital programs like renewable energy mandates. It brings everyone—including our visitors who pay the fee when they buy fuel—into the solution, reducing pollution and bolstering our energy independence.

This policy is not theoretical; it implements key recommendations from the state’s own Tax Review Commission and Climate Commission. Carbon pricing has proven successful in other jurisdictions, and a cashback model enjoys broad support because it is transparent, effective, and fair.

We must act with both ambition and justice. HB1617 reduces the pollution that threatens our islands and returns the proceeds to our people, helping kama‘aina families afford the transition to a clean energy future. I urge you to pass this critical legislation.

Mahalo for the opportunity to testify.

HB-1617
Submitted on: 2/10/2026 11:35:35 AM
Testimony for EEP on 2/12/2026 10:20:00 AM

Submitted By	Organization	Testifier Position	Testify
Caroline Azelski	Individual	Support	Written Testimony Only

Comments:

In support of. Thank you.

HB-1617
Submitted on: 2/10/2026 11:38:26 AM
Testimony for EEP on 2/12/2026 10:20:00 AM

Submitted By	Organization	Testifier Position	Testify
Benjamin Narwold	Individual	Support	Written Testimony Only

Comments:

A

loha Chair Lowen and Vice Chair Perruso, Committee on Energy & Environmental Protection, and Chair Chun and Vice Chair Kusch, Committee on Agriculture & Food Systems,

I strongly support this bill because it reduces climate pollution and increases Hawai‘i’s energy independence while financially helping vulnerable kama‘aina families.

The bill places a gradually rising carbon fee on fossil fuels, incentivizing businesses and individuals to use less fossil fuels, the emissions from which are warming the Earth and creating climate havoc in Hawai‘i and globally.

The policy is budget neutral. The carbon fee revenues are used to fund a climate rebate that is distributed to Hawai‘i tax filers. The climate rebate makes the bill progressive and protects vulnerable lower-income families.

The bill is simple to administer because it relies on existing mechanisms to collect the carbon fee and distribute the climate rebates.

Hawai‘i must take a multi-pronged approach to reduce carbon emissions and lessen our dependence on fossil fuels that are subject to the price volatility of the global market while financially helping our kama‘aina make the transition. This bill helps achieve those goals efficiently and equitably, and works well with other policy approaches.

Mahalo!

Benjamin Narwold, Kapaa, Hawaii

HB-1617
Submitted on: 2/10/2026 11:42:23 AM
Testimony for EEP on 2/12/2026 10:20:00 AM

Submitted By	Organization	Testifier Position	Testify
Thomas Brandt	Individual	Support	Written Testimony Only

Comments:

Strong support.

HB-1617
Submitted on: 2/10/2026 12:08:47 PM
Testimony for EEP on 2/12/2026 10:20:00 AM

Submitted By	Organization	Testifier Position	Testify
Lorn Douglas	Individual	Support	Written Testimony Only

Comments:

Please support this measure to reduce our consuption of fossil fuels.

HB-1617
Submitted on: 2/10/2026 12:12:33 PM
Testimony for EEP on 2/12/2026 10:20:00 AM

Submitted By	Organization	Testifier Position	Testify
Ronald "Ron" Reilly	Individual	Support	Written Testimony Only

Comments:

Dear Chair Lowen, Chair Chun and members of the EEP and AGR Committees,

My name is Ron Reilly and I am in strong support of HB1617. Carbon pricing is recognized around the world as an essential strategy in climate change mitigation efforts.

When coupled with a dividend – carbon tax revenue returned to households – the impact on middle and lower-income families is positive.

There is a concern that some long distance drivers, who are employed far from their homes, may be adversely affected i.e., the amount of the refundable income tax credit, provided by HB1617, might be marginally less than their increased transportation expense.

I respectfully suggest that this concern can be more effectively addressed in other bills rather than by HB1617. Measures should include:

1- HB2038 that (when passed) will provide up to $5,000 cash to long distance drivers who switch to an EV or other more efficient transportation mode.

2- Identify and expand public transportation options and park-and-ride facilities e.g., Saddle road Hilo to Kona and Waikoloa.

3- Create free/or low-cost housing options for long-distance employees near hotels and other large employers – possibly similar to Hale Pohaku that accommodates up to 72 summit workers at the Mauna Kea observatories.

Thank you for your consideration. Please pass HB1617.

Ron Reilly, Volcano Village
Climate Solutions Advocate

February 12, 2026

Aloha Chair Lowen and Vice Chair Perruso, Committee on Energy & Environmental Protection, and Chair Chun and Vice Chair Kusch, Committee on Agriculture & Food Systems

Strongly support HB1617

As a Hawai'i resident I've become increasingly concerned about the amount of fossil fuels we import, at great expense to the Hawaiian economy. For greater prosperity and resilience we must take several measures to mitigate fossil fuel dependency. Hawaii must take measures to insulate ourselves from market and geopolitical disruptions.

HB1617 is one of the needed measures offering residents the financial means to adapt in a just and equitable manner.

If enacted HB1617 would;

- Be cost-effective policy to reduce carbon emissions as it corrects an existing market failure by internalizing the social cost of burning fossil fuels. It addresses carbon emissions in all sectors of the economy, unlike a narrowly focused gasoline tax.
- Protects low-income households by prepaying the dividend or cashback before the carbon fee goes into effect, and it is progressive, as the cashback increases inversely with income.
- Complement other emission reduction policies. When these policies are combined with price incentives, such as carbon cashback, these policies can result in significant emission reductions.
- Regulatory implementation is relatively simple, as it uses existing administrative processes for the barrel tax and income tax to collect the carbon fee and pay the tax credits.
- Makes Agriculture Development and Food Security Fund connection.

Thank you for your consideration.
Keith Neal
Waimea

HB-1617
Submitted on: 2/10/2026 12:33:46 PM
Testimony for EEP on 2/12/2026 10:20:00 AM

Submitted By	Organization	Testifier Position	Testify
Yanrong Chen	Individual	Support	Written Testimony Only

Comments:

Aloha Chair Gabbard, Vice Chair Richards, and members of the Committee on Agriculture and Environment

Thank you for this opportunity to testify in support of HB1617!

As a rising junior of ʻIolani School, I have grown to become more climate conscious then ever. I'm an avid hiker and passionate conservationist that have walked the trails of our Wai'anae mountains. I have personally felt the disappointment when less and less ʻelepaio return and take shelter in our valleys because of climate change and habitat loss. Climate change is a problem that is currently happening now, and it is more urgent than ever that we speak out about it. This is no longer just an issue for those impacted by wildfires and coastal flooding, it is a kākou (everybody's) problem. I urge for the passing of this bill as it reduces climate pollution and increases Hawaiʻi's energy independence while financially helping vulnerable kamaʻaina families. I was often told as a child to finish the food I ate as we would only be running on ketchup packets and M&Ms if not for importations. I believe this ideology also applies for Hawai'i's energy dependence. This bill will be able to support this need of our society now.

The bill places a gradually rising carbon fee on fossil fuels, incentivizing businesses and individuals to use less fossil fuels, the emissions from which are warming the Earth and creating climate havoc in Hawaiʻi and globally. I feel personally passionate about global warming as this also affects the native birds of the Haleakala. Again, less and less places are becoming habitable for these endemic birds, and I urge for more protection against global warming.

The policy is budget neutral. The carbon fee revenues are used to fund a climate rebate that is distributed to Hawaiʻi tax filers. The climate rebate makes the bill progressive and protects vulnerable lower-income families.

The bill is simple to administer because it relies on existing mechanisms to collect the carbon fee and distribute the climate rebates.

Hawaiʻi must take a multi-pronged approach to reduce carbon emissions and lessen our dependence on fossil fuels that are subject to the price volatility of the global market while financially helping our kamaʻaina make the transition. This bill helps achieve those goals efficiently and equitably, and works well with other policy approaches.

Mahalo!
Yanrong Chen, Kapahulu/Mo’ili’ili

HB-1617
Submitted on: 2/10/2026 12:33:59 PM
Testimony for EEP on 2/12/2026 10:20:00 AM

Submitted By	Organization	Testifier Position	Testify
Gina Kim	Individual	Support	Written Testimony Only

Comments:

Thank you for the opportunity to testify in support of HB1617, which seeks to benefit numerous sectors: economic, environmental, and agricultural, and more in our state through a constructive and sustainable approach.

As a high school boarding student who is originally from Korea, this bill is important to me in that I believe in creating real impact through daily decisions. As I first settled in, as much as I appreciated the beautiful nature and islands, I also noticed the various issues the state faces contrary to the overly idealized image of "paradise." Frankly, I only came to understand that Hawai‘i is where people actually live, find joy, struggle, and make daily decisions as I came here. In that sense, I believe in creating change in everyday choices—the very aspect I overlooked when I was so oblivious of this place.

In that spirit, carbon cashback is one of the most applicable climate policies with direct impact in our daily lives. SB2332 addresses some of the most crucial issues in our state through increasing the tax rate of environmental response, energy, carbon emissions, and food security, while returning the revenue back to the state in the form of refundable income tax credit for the people and reinvesting in local agriculture and food security.

Because the bill raises the tax rate gradually over time, it encourages a smoother transition to clean energy with relatively less side effects. The cost of living is another serious concern in the state; because the revenue directly goes back to the people as refundable tax credit, it helps mitigate the financial burden, especially for lower-income households; the bill in fact aims to provide a net financial benefit to most of them. In other words, while leading Hawai‘i towards a sustainable future, it also ensures that most families benefit, if not are protected in the process.

Another aspect of this bill is to reenact the agricultural development and food security fund. It is already widely known that food insecurity is one of the most long-lasting and significant issues locally, and if more investments are to be made, with grants to farmers and in areas such as research, irrigation, and local food marketing, there is hope to see improvements in the status quo.

At a time with much uncertainty in federal support and the accelerating impact of climate change, respectfully, it is crucial that the state legislature supports bills that ensure sustainability for the future generation, food security for public health and the environment, and the economy for the well-being of all. As a foreigner, an aspect I genuinely look up to about Hawai‘i’s

policies is in its dedication to protecting the lands, waters, and air, such as the state's zero emissions clean economy target, and I hope to see Hawai‘i continuing to be an avid advocate for the environment.

Thank you for your support in the well-being and safety of present and future generations. I respectfully urge the Committee to pass this bill.

Sincerely,

Gina Kim

HB-1617
Submitted on: 2/10/2026 12:44:17 PM
Testimony for EEP on 2/12/2026 10:20:00 AM

Submitted By	Organization	Testifier Position	Testify
Daniel Ward	Individual	Support	Written Testimony Only

Comments:

Aloha,

I strongly support this bill because it reduces climate pollution and increases Hawai'i's energy independence while financially helping vulnerable kama'aina families.

I am a 16-year old student at Iolani, and I want to support this bill because I care deeply about issues affecting the environment. I have recently started volunteering at a forest restoration site and have seen hands-on what the efforts of the community can do to restore native ecosystems in Hawai'i. I also know how vulnerable these ecosystems are, and how much fossil fuel usage harms these valuable regions. I know Carbon Cashback is relatively easy to implement because it uses existing administrative mechanisms, and carbon pricing is efficient as well. I hope that we can replicate the success that carbon cashback has had elsewhere in our state. As I experience the nature of the Hawaiian Islands more and more, whether in the ocean or the mountains, I recognize just how fragile these islands are, and I want to do everything in my power to fight against anything that is causing harm to this land. This bill helps achieve these goals efficiently and equitably, and works well with other policy approaches.

Mahalo!

Daniel Ward, Honolulu

HB-1617
Submitted on: 2/10/2026 12:51:46 PM
Testimony for EEP on 2/12/2026 10:20:00 AM

Submitted By	Organization	Testifier Position	Testify
Linus Lum	Individual	Support	Written Testimony Only

Comments:

To: Committee Chair and Members

From: Linus Lum, Sophomore at ‘Iolani School

Aloha Chair and Committee Members,

I strongly support SB2332 because it positively affects our environment and protects our natural reasorces on this planet. It tax on carbon emissions brings more attention to our climate and the issues that are rapidly escalating.

I am a sophomore student at Iolani, and I belive that this bill will bring more attention to my future and all the others around me. I grew up around the ocean, and always wanted to protected and preserve it. I often participated in beach cleanups and joined classes to further understand the severity of climate change and its effects.

In school, I attended a sustainability semester course where we understood and reasercherd on the urgent need to balance Hawai‘i's environmental protection with economic resilience. I am confident that SB2332 offers a comprehensive solution by reestablishing the Agricultural Development and Food Security Special Fund alongside the new Carbon Emissions Tax and Dividend Special Fund.

By gradually increasing tax rates on energy and emissions while simultaneously establishing a refundable carbon cashback tax credit, this bill ensures that the transition to a greener economy remains affordable for most taxpayers. The inclusion of mandatory legislative reporting and dedicated funding appropriations ensures that this system is not only transparent but also strategically managed to secure our island's food and energy future.

Mahalo!

Linus Lum

HB-1617
Submitted on: 2/10/2026 12:52:57 PM
Testimony for EEP on 2/12/2026 10:20:00 AM

Submitted By	Organization	Testifier Position	Testify
Thomas Graham	Individual	Support	Remotely Via Zoom

Comments:

Aloha Chair, Vice Chairs, and members of the Committees on Energy & Environmental Protection and Agriculture & Food Systems,

I strongly support HB1617. This carbon cashback program will reduce carbon emissions, decrease our dependence on price-volatile imported fossil fuels, and go a long way toward meeting our climate and energy security goals. At the same time, it will financially protect lower-income households as we transition to a carbon-free economy.

The bill implements the top recommendation of Hawaii's 2020-2022 Tax Review Commission and key recommendations of the Hawai‘i State Energy Office and the Hawai‘i Climate Change Mitigation and Adaptation Commission.

Carbon cashback is not the only policy needed to meet Hawaii's energy and climate goals, but it's clear from the UH study commissioned by the Legislature a few years ago that it's the most cost-effective and equitable policy available to us. We should take advantage of it.

Thank you,

Thomas Graham, Honolulu

HB-1617
Submitted on: 2/10/2026 12:54:56 PM
Testimony for EEP on 2/12/2026 10:20:00 AM

Submitted By	Organization	Testifier Position	Testify
George Liu	Individual	Support	Written Testimony Only

Comments:

Hello, my name is George Liu, and I'm an international student going to Iolani school as a junior as of the moment. I came from China, a place that was once known for its ridiculous level of pollution, particularly in its 1st grade cities (Beijing, Shanghai, Shenzhen, Guangzhou). After experiencing severe levels of fog through my ridiculous childhood, I had realized the genuine need for environment-positive policies such as these, as well as these bills' potential as China's environmental pollution reduced over time. As time moves on and the environment keeps getting polluted, humans will have to eventually switch to more sustainable energy in order to preserve what little we still have left. Let's encourage this switch early and assist our citizens with this carbon cashback bill!

HB-1617
Submitted on: 2/10/2026 1:46:03 PM
Testimony for EEP on 2/12/2026 10:20:00 AM

Submitted By	Organization	Testifier Position	Testify
Mary Lu Kelley	Individual	Support	Written Testimony Only

Comments:

Aloha Chair Lowen and Vice Chair Perruso, Committee on Energy & Environmental Protection, and Chair Chun and Vice Chair Kusch, Committee on Agriculture & Food Systems,

I strongly support this bill because it reduces climate pollution and increases Hawai‘i’s energy independence while financially helping vulnerable kama‘aina families.

The bill places a gradually rising carbon fee on fossil fuels, incentivizing businesses and individuals to use less fossil fuels, the emissions from which are warming the Earth and creating climate havoc in Hawai‘i and globally.

The policy is budget neutral. The carbon fee revenues are used to fund a climate rebate that is distributed to Hawai‘i tax filers. The climate rebate makes the bill progressive and protects vulnerable lower-income families.

The bill is simple to administer because it relies on existing mechanisms to collect the carbon fee and distribute the climate rebates.

Hawai‘i must take a multi-pronged approach to reduce carbon emissions and lessen our dependence on fossil fuels that are subject to the price volatility of the global market while financially helping our kama‘aina make the transition. This bill helps achieve those goals efficiently and equitably, and works well with other policy approaches.

Mahalo!

Mary Lu Kelley. Koloa, HI

HB-1617
Submitted on: 2/10/2026 1:50:09 PM
Testimony for EEP on 2/12/2026 10:20:00 AM

Submitted By	Organization	Testifier Position	Testify
Bobbie Best	Individual	Support	Written Testimony Only

Comments:

This bill will reduce fossil fuel imports and climate pollution, making Hawaii more energy-independent while financially benefitting lower income families plus reestablished the Agricultural Development and Food Security Fund. PLEASE PASS IT.

Mahalo nui

HB-1617
Submitted on: 2/10/2026 2:29:48 PM
Testimony for EEP on 2/12/2026 10:20:00 AM

Submitted By	Organization	Testifier Position	Testify
Melissa Barker	Individual	Support	Written Testimony Only

Comments:

Honorable Members,

I am writing to ask that you please support HB1617 which will reduce fossil fuel imports and climate pollution in Hawai‘i.

Thank you for your attention and consideration.

Sincerely,

Melissa Barker

Kapaa, HI 96746

HB-1617
Submitted on: 2/10/2026 3:29:32 PM
Testimony for EEP on 2/12/2026 10:20:00 AM

Submitted By	Organization	Testifier Position	Testify
Douglas Perrine	Individual	Support	Written Testimony Only

Comments:

I support HB1617 - a budget neutral measure to increase our energy independence, reduce pollution, and protect our climate.

HB-1617
Submitted on: 2/10/2026 3:57:31 PM
Testimony for EEP on 2/12/2026 10:20:00 AM

Submitted By	Organization	Testifier Position	Testify
Eric Lindborg	Individual	Support	Written Testimony Only

Comments:

Carbon Cashback proposals continue to merit broad attention and support. This bill should facilitate a transition away our dependence on fossil fuels and incentivize adoption of energy sources that are locally sustainable and resilient over the long term. The cashback provision helps our kamaʻaina make the transition. The carbon fee works efficiently and equitably, and it works well with other policy approaches.

HB-1617
Submitted on: 2/10/2026 4:25:48 PM
Testimony for EEP on 2/12/2026 10:20:00 AM

Submitted By	Organization	Testifier Position	Testify
Megan Conley	Individual	Support	Written Testimony Only

Comments:

Aloha Chair Lowen and Vice Chair Perruso, Committee on Energy & Environmental Protection, and Chair Chun and Vice Chair Kusch, Committee on Agriculture & Food Systems,

I strongly support this bill because it reduces climate pollution and increases Hawai‘i’s energy independence while financially helping vulnerable kama‘aina families.

The bill places a gradually rising carbon fee on fossil fuels, incentivizing businesses and individuals to use less fossil fuels, the emissions from which are warming the Earth and creating climate havoc in Hawai‘i and globally.

The policy is budget neutral. The carbon fee revenues are used to fund a climate rebate that is distributed to Hawai‘i tax filers. The climate rebate makes the bill progressive and protects vulnerable lower-income families.

The bill is simple to administer because it relies on existing mechanisms to collect the carbon fee and distribute the climate rebates.

Hawai‘i must take a multi-pronged approach to reduce carbon emissions and lessen our dependence on fossil fuels that are subject to the price volatility of the global market while financially helping our kama‘aina make the transition. This bill helps achieve those goals efficiently and equitably, and works well with other policy approaches.

Mahalo nui for your consideration.

Megan Conley, Nu'uanu

HB-1617
Submitted on: 2/10/2026 6:43:21 PM
Testimony for EEP on 2/12/2026 10:20:00 AM

Submitted By	Organization	Testifier Position	Testify
Jonathan Simonds	Individual	Support	Written Testimony Only

Comments:

Please support HB1617!! I absolutely love this idea. We're decades too late to start pricing carbon, but no time like the present. And the genius of this method is that it's designed to minimize the burden on consumers. In fact, consumers who respond to the incentive structure should come out ahead.

I feel that this bill is carefully crafted and thoughtful to make carbon pricing even more palatable. No matter how we do it, carbon pricing is *critical* to properly accounting for the spatially and temporally externalized costs of business as usual. Whether or not a free market economy is the best the system possible is up for debate, but it's the system that we have and under this system, efficient markets require accurate price signals. When externalities are present, it is the role of the government to recognize and correct for them.

Please step into your role and begin to price carbon fairly. Please deliver the spoils back to the people and organizations that need it to effect positive change in their communities.

Please support HB1617.

Sincerely,

Jonathan Simonds
Hilo, HI 96720

House Committee on Energy & Environmental Protection
House Committee on Agriculture & Food Systems
HB1617 Hearing
Feb. 12, 2026 at 10:20 am
Conference Room 325 and via videoconference

SUPPORT

My name is John Kawamoto, and I strongly support this bill.

This bill brings together two proven policy tools -- carbon pricing and refundable tax credits -- in a way that is both innovative and practical. One tool is widely used around the world, and the other is already used successfully here in Hawai‘i. Together, they cut climate pollution while putting money directly into the pockets of Hawaii's families.

The first tool is carbon pricing, which is currently used in some form by 55 countries, according to the World Bank. Carbon pricing is one of the most effective ways to reduce fossil fuel emissions while allowing economies to grow. The World Bank states that "carbon pricing is widely recognized as an important tool to incentivize low-carbon economic growth."

Globally, carbon pricing programs now generate more than $100 billion per year. Revenues from carbon pricing are used by various countries to fund clean energy infrastructure, support vulnerable communities, assist families financially, or a combination of these approaches.

The second tool is the refundable tax credit, which Hawai‘i already uses to support specific populations, including working families and low-income households. Examples include the Food/Excise Tax Credit, Earned Income Tax Credit, Low-Income Household Renters Tax Credit, and Child Tax Credit. Refundable credits ensure that financial assistance reaches those who need it most, including families who owe little or no income tax.

This bill's innovation is that it combines carbon pricing with refundable tax credits so that climate action also reduces the financial burden on residents. The bill applies a gradually increasing carbon price using Hawai‘i's existing Environmental Response, Energy, and Food Security Tax, which is assessed upstream on fossil fuel distributors. All revenue is returned directly to residents through a refundable tax credit. Each adult is eligible for a full share, and each dependent is eligible for a half share. This structure ensures fairness, simplicity, and minimal administrative burden.

Importantly, this policy is revenue-neutral and self-funding. A University of Hawaii study commissioned by the Legislature estimates that it will reduce greenhouse gas emissions by 13% while providing a net financial benefit to most households. Low-income families are projected to receive the largest net gains, helping them cope with the high cost of living.

This bill advances Hawai‘i's climate and energy goals, reduces dependence on imported fossil fuels, strengthens household financial security, and does so in a fair and fiscally responsible manner.

For these reasons, I urge the committee to pass this bill.

HB-1617
Submitted on: 2/10/2026 8:13:21 PM
Testimony for EEP on 2/12/2026 10:20:00 AM

Submitted By	Organization	Testifier Position	Testify
Glen Kagamida	Individual	Support	Written Testimony Only

Comments:

STRONG SUPPORT!

Aloha Chair Lowen and Vice Chair Perruso, Committee on Energy & Environmental Protection, and Chair Chun and Vice Chair Kusch, Committee on Agriculture & Food Systems,

My name is Mia Nishiguchi, and I am a senior at Kalani High School. **I strongly support HB1617** because it reduces climate pollution, increases Hawai‘i’s energy independence, and helps vulnerable kama‘aina families financially.

The bill imposes a gradually rising carbon fee on fossil fuels, incentivizing businesses and individuals to use less of them, whose emissions are warming the Earth and causing climate havoc in Hawai‘i and globally.

The policy is budget-neutral. The carbon fee revenues are used to fund a climate rebate that is distributed to Hawai‘i tax filers. The climate rebate makes the bill progressive and protects vulnerable lower-income families.

The bill is simple to administer because it relies on existing mechanisms to collect the carbon fee and distribute the climate rebates.

Carbon Cashback supports the futures of youth, like me, who will live with the long-term consequences of today’s policy decisions. As a student preparing for college and a career focused on public service and sustainability, I want to grow up in a Hawai‘i that is resilient, affordable, and powered by clean energy rather than increasingly dependent on imported fossil fuels. This bill invests in that future by reducing pollution now and putting money back into the pockets of families already struggling with rising costs.

Hawai‘i must take a multi-pronged approach to reduce carbon emissions and lessen our dependence on fossil fuels, which are subject to global market price volatility, while helping our kama‘aina make the transition. This bill helps achieve those goals efficiently and equitably, and works well with other policy approaches.

Mahalo for the opportunity to testify.

Mia Nishiguchi
Kalani High School

HB-1617
Submitted on: 2/10/2026 9:04:58 PM
Testimony for EEP on 2/12/2026 10:20:00 AM

Submitted By	Organization	Testifier Position	Testify
Jeanne Dennis	Individual	Support	Written Testimony Only

Comments:

Aloha Chair Lowen and Vice Chair Perruso, Committee on Energy & Environmental Protection, and Chair Chun and Vice Chair Kusch, Committee on Agriculture & Food Systems,

I strongly support this bill because it reduces climate pollution and increases Hawai‘i’s energy independence while financially helping vulnerable kama‘aina families.

The bill places a gradually rising carbon fee on fossil fuels, incentivizing businesses and individuals to use less fossil fuels, the emissions from which are warming the Earth and creating climate havoc in Hawai‘i and globally.

The policy is budget neutral. The carbon fee revenues are used to fund a climate rebate that is distributed to Hawai‘i tax filers. The climate rebate makes the bill progressive and protects vulnerable lower-income families.

The bill is simple to administer because it relies on existing mechanisms to collect the carbon fee and distribute the climate rebates.

Hawai‘i must take a multi-pronged approach to reduce carbon emissions and lessen our dependence on fossil fuels that are subject to the price volatility of the global market while financially helping our kama‘aina make the transition. This bill helps achieve those goals efficiently and equitably, and works well with other policy approaches.

Mahalo!

Jeanne Dennis, Kaneohe

Aloha Chair Lowen, Chair Chun, and members of the EEP and AFS committees:

I strongly support HB1617 because it would reduce climate pollution and increases Hawai‘i’s energy independence while financially helping vulnerable kama‘aina families. Studies *have shown that* Carbon cashback would benefit low- and middle-income households and the Hawai’i Tax Review Commission’s top recommendation in its final report for the 2020-2022 legislature was a carbon tax for Hawai’i.

Carbon taxes or similar emissions pricing initiatives have been implemented in over 50 jurisdictions worldwide. This carbon cashback bill for Hawai’i, HB1617, places a gradually rising carbon fee on fossil fuels, incentivizing businesses and individuals to use less fossil fuels, the emissions from which are warming the Earth and creating climate havoc in Hawai‘i and globally.

Urgent effective action on climate change is needed to maintain the livability of our planet. In Hawai’i, we are seeing many terrible results of climate change which we cannot ignore. Without correcting our course, I expect our lives will rapidly go downhill as we experience increasingly bad storms, floods, heat waves, wildfires, and droughts, and other effects as greenhouse gasses increase. The increasing global heat is rapidly melting polar ice and the increased ocean acidity from carbon dioxide will continue to ruin our reefs. The combined effects will speed up coastal erosion and destroy life in our oceans. Meanwhile we can expect more avian malaria and other deadly diseases that are killing wildlife like the birds in our mountains and other mosquito-borne diseases that may kill you and me. Life will be increasingly difficult, and we will go broke trying to replace buildings, roads, and other infrastructure.

The policy is budget neutral. The carbon fee revenues are used to fund a climate rebate that is distributed to Hawai‘i tax filers. The climate rebate makes the bill progressive and protects vulnerable lower-income families.

The bill is simple to administer because it relies on existing mechanisms to collect the carbon fee and distribute the climate rebates.

Hawai‘i must take a multi-pronged approach to reduce carbon emissions and lessen our dependence on fossil fuels that are subject to the price volatility of the global market while financially helping our kama‘aina make the transition. This bill helps achieve those goals efficiently and equitably, and works well with other policy approaches.

In addition to supporting this bill I support HB2030 which complements this bill by making it easier for people who have long commutes invest in an electric vehicles so they can avoid the use and cost of fossil fuels.

Mahalo!

Charles E Cox, Honolulu

HB-1617
Submitted on: 2/11/2026 12:02:50 AM
Testimony for EEP on 2/12/2026 10:20:00 AM

Submitted By	Organization	Testifier Position	Testify
Jaymen Laupola	Individual	Support	Written Testimony Only

Comments:

Aloha Chair Lowen and Vice Chair Perruso, Committee on Energy & Environmental Protection, and Chair Chun and Vice Chair Kusch, Committee on Agriculture & Food Systems,

I strongly support this bill because it reduces climate pollution, strengthens Hawai‘i’s energy independence, and financially supports vulnerable kama‘āina families.

This measure places a gradually rising carbon fee on fossil fuels, creating a clear market signal to reduce reliance on fuels that are driving climate disruption in Hawai‘i and around the world. By encouraging cleaner alternatives, it helps accelerate our transition to a more resilient energy system.

Importantly, the policy is budget-neutral. Carbon fee revenues are returned to Hawai‘i tax filers through a climate rebate, making the program progressive and protecting lower-income households from increased costs.
The bill is also practical and efficient, relying on existing mechanisms to collect the fee and distribute rebates.

Hawai‘i must take a multi-pronged approach to cut emissions, reduce exposure to global fossil fuel price volatility, and support families through the transition. This bill advances those goals in a fair, economically sound, and administratively feasible way.

Mahalo for your consideration.

Tom Dale & Vernon Gill Carter

TOPSOIL AND CIVILIZATION

University of Oklahoma Press
NORMAN
Library of Congress Catalog Card Number: 55-9630

THIS BOOK IS DEDICATED TO

two great conservationists: David A. Aylward and Hugh H. Bennett.

To: Dave Aylward, former president of the National Wildlife Federation, because it was he who first gave the authors the assignment of writing the book, helped them outline the contents, and encouraged them to continue their work to completion.

To: Hugh Bennett, former chief of the United States Soil Conservation Service, because he is the greatest disciple of soil conservation in the world and furnished much of the inspiration and many of the ideas for the book.

PREFACE

WITH THE PROGRESS of civilization, man has learned many skills, but only rarely has he learned to preserve his source of food. Paradoxically, the very achievements of civilized man have been the most important factors in the downfall of civilizations. This book does not offer a panacea to a world plagued by survival problems, but it does attempt to analyze the fundamental reasons for the rise and fall of the world's great civilizations; and by this analysis it may be possible to determine means not only of preserving our present civilization, but of restoring to productivity some of the previously ruined areas of the world. This is not a technical study of history based on firsthand knowledge or original research. It is a summary of conclusions and interpretations of history arrived at after long study and wide reading, mainly of secondary source materials.

We recognize that there are bound to be some errors in the text, both in facts and interpretation of facts. Obviously, the authors could not check fully all details of history in a field as broad as that discussed. And some of our conclusions are based on logic rather than known facts. This was sometimes necessary because all the facts were not known. We think, however, that the basic arguments presented and the general conclusions are sound and essentially correct.

Other writers have expounded somewhat the same general arguments that we are presenting. Some of them have given more or less detailed discussions on certain areas. As far as we know, however, no other writer or historian has ever attempted to analyze the entire field of world history from the point of view of man's relation to productive soil.

Man's relation to the land from which he lives is an important field of historical study that has been sadly neglected. We realize that we have merely scratched the surface, as far as the possibilities of research in this field exist, and we invite research historians and others to explore this field of historical research and interpretation more fully. We think that most of those who do so will find the subject as fascinating as we found it. It is quite possible that detailed research and study by trained historians may prove that some of our specific conclusions are unsound and that some of our specific interpretations are distortions. Nevertheless, we think that such research will prove the soundness of our main arguments, and will substantiate most of our specific conclusions and interpretations.

ACKNOWLEDGMENTS

WE WISH TO ACKNOWLEDGE that it was mainly the historical research and interpretive writing of many unnamed authors that made this book possible. In addition to the historical writers drawn upon so freely, the authors wish to express appreciation to the many individuals who gave us ideas, facts, and encouragement.

A tentative draft of this book was duplicated by the National Wildlife Federation in the fall of 1951. This draft was circulated among key members of the Federation and others for review. Among those who reviewed the manuscript and offered constructive criticism, specific ideas for improvement, or encouragement, were: Messrs. Thomas Harrison of Rockville, Maryland; Tom B. Jones, research historian of the University of Minnesota; Clarence Cottam, assistant director of the United States Fish and Wildlife Service; Gilbert R. Dale, head of social studies at Adams State College, Colorado; Frank H. Gafford, head of the history department of North Texas State College; Paul H. Oehser, chief of the editorial division of the Smithsonian Institution; B. B. Harris of North Texas State College; Leslie F. Smith, professor of ancient and medieval history in the University of Oklahoma; Goldwin Smith, professor of history at Wayne University; Homer L. Shantz of Santa Barbara, California; G. W. McCullough, wildlife technician of the Federal Cartridge Corporation; John A. Hussey, of the history branch of the National Park Service; Daniel L. Leedy, biologist of the United States Fish and Wildlife Service; Walter P. Taylor, Carl D. Shoemaker, and J. N. Darling of the National Wildlife Federation; Ira Gabrielson and C. R. Gutermuth of the Wildlife Management Institute; C. W. Mattison and Lloyd W. Swift of the United States Forest Service; and H. H. Finnell, T. L. Gaston, G. K. Zimmerman, H. D. Simms, and L. R. Combs of the Soil Conservation Service. All of these people, and others, helped correct mistakes in the tentative draft or contributed additional ideas and facts. But they are not responsible for any of the ideas, interpretations, or conclusions presented by the authors.

Then we must express special gratitude to all the officials of the National Wildlife Federation, who helped sponsor the book during the years it was in formative stage, and especially to David A. Aylward, the late Charles T. Vorhies, Walter P. Taylor, Lloyd F. Wood, and Ash Brownridge. The book would probably never have been written except for the sponsorship and encouragement of these men and other officials of the Federation.

We also owe special thanks to Miss Ruth Nordin, head of the editorial section of the Soil Conservation Service, who edited the final draft of the manuscript and gave many helpful suggestions. Fred G. Renner and Glen E. Riddell, of the Soil Conservation Service, furnished most of the photographs used in the chapters on Greece, Italy, and Sicily. Roy Sapp, of the Soil Conservation Service, took special pains in producing excellent prints of most of the photographs used.

CONTENTS

1. AN OVERVIEW

WHEN THE earth was young, there was no life and no soil on this planet. Living things first appeared in some of the seas or oceans about two billion years ago, according to the most generally accepted estimates. For about one and two-thirds billion years, however, living things were restricted to the waters of the oceans, seas, lakes, and rivers. And there was no soil as we know it today.

Until about 350,000,000 years ago, the continents and islands that projected above the surface of the oceans were covered with bare rock or sterile rock particles that had been separated from the parent material by the elements. There were some accumulations of water-borne gravel, sand, or silt in depressions and along the shores. There were some windblown sand dunes in desert climates. But these accumulations of silt, sand, and gravel contained no organic matter and supported no life. Erosion by water and wind kept most of the land surface bare of anything but solid rock.

During the Silurian period, about 350,000,000 years ago, primitive plants and animals began to establish themselves on land. This was the beginning of soil formation--soil that would support life. Through millions of years, some plants gradually adapted themselves to living farther and farther from their native homes, the seas. These land plants drew their sustenance from the air, sunlight, and rain, and from the minerals in the rock particles that anchored them. First they covered the coasts and valleys where there were accumulations of sand and silt. Then they started up the hillsides. As they crept up the slopes of eroding hills and mountains, their roots helped bind the fine rock particles together. This slowed down the erosion process that had kept these slopes bare of soil. Gradually, hillsides were covered with a mantle of vegetation and soil. In the meantime, the valleys were being covered with thicker layers of soil and denser vegetation.

The soil layer on the hillsides was thin at first, but it became thicker from century to century and millenium. to millenium. The plants and their roots trapped more and more of the fine rock particles that previously had been washed downhill to the seas or blown into sand dunes. As each plant died, it added its organic remains to the minerals of the rock particles. Bacteria and other forms of simple plant life began to live off the organic matter in the newly made soil.

Meanwhile, the many species of small animals that fed upon the plants had followed their hosts inland. Some of the primitive animals lived on the ground surface and fed upon the exposed portions of the plants or upon each other. Other species burrowed into the ground and fed upon the plant roots or the decaying organic matter in the soil. All of them added their dead carcasses to the soil, still further enriching it. Thus began the formation of what we now know as topsoil--the upper layer of earth that is rich in organic matter and is teeming with minute plant and animal life.

Land-based plants and animals and the soil that supported them all continued to grow through the milleniums. Interdependent, they thrived mainly because they supported each other. As the soil became richer and deeper, the plants became larger and more numerous. As plant growth became more luxuriant, the number and size of animals increased. The greater masses of living things added more organic matter to the soil as they perished, and they helped trap and hold more rock particles. This, in

turn, made the soil still richer and deeper, and as the cycle continued, the amount of life supported by the soil eventually rivaled that of the oceans. And the land plants and animals evolved to higher forms than the oceans could produce.

The laws of "natural selection" forced practically all plants and animals to support the soil-building process. No species of plant could long survive on sloping hillsides unless it helped check soil erosion. No species of animal developed enough intelligence or versatility to survive for long unless it tended to support the continued growth of plants and soil. If a species of plant or animal did evolve that tended to destroy the soil, it usually destroyed itself instead by destroying its primary source of food.

For about 350,000,000 years, the growth of soil and land-based life continued. The quantity and quality of soil and life increased. Earth upheavals, broad climatic changes, and other natural phenomena caused destruction of both soil and life in many regions at times. But over the earth as a whole, the soil-building process went on. And the evolution of plants and animals to higher forms and greater abundance continued.

Primitive man came on the scene about one million years ago. He did not upset the natural process of soil, plant, and animal growth. He, like other animals, was forced to adapt himself to his natural environment in order to survive--that is, until he became civilized enough to master the other animals and the plants and attempt to master Nature herself.

With the advent of civilized man, about six thousand years ago, the soil-building process was reversed in most areas where he resided: the quantity and quality of soil and the amount of life the soil supported all began to decline. His superior tools and intelligence enabled civilized man to domesticate or destroy a great part of the plant and animal life around him. But more important, his improved tools and techniques helped him, unwittingly, to destroy the productivity of the soil that supported life. His intelligence and versatility made it possible for him to do something no other animal had ever been able to do--greatly alter his environment and still survive and multiply.

Civilized man was nearly always able to become master of his environment temporarily. His chief troubles came from his delusions that his temporary mastership was permanent. He thought of himself as "master of the world," while failing to understand fully the laws of nature.

Man, whether civilized or savage, is a child of nature--he is not the master of nature. He must conform his actions to certain natural laws if he is to maintain his dominance over his environment. When he tries to circumvent the laws of nature, he usually destroys the natural environment that sustains him. And when his environment deteriorates rapidly, his civilization declines.

One man has given a brief outline of history by saying that "civilized man has marched across the face of the earth and left a desert in his footprints." This statement may be somewhat of an exaggeration, but it is not without foundation. Civilized man has despoiled most of the lands on which he has lived for long. This is the main reason why his progressive civilizations have moved from place to place. It has been a chief cause for the decline of his civilizations in older settled regions. It has been a dominant factor in determining all trends of history.

The writers of history have seldom noted the importance of land use. They seem not to have recognized that the destinies of most of man's empires and civilizations were

determined largely by the way the land was used. While recognizing the influence of environment on history, they fail to note that man usually changed or despoiled his environment.

Many historians point out the fact that most wars and colonizing movements were started because someone wanted more land. But seldom do they note that the conquerors or colonizers had often ruined their own land before they started to take that of their neighbors. Most writers of current history recognize that the strong and wealthy nations of today are those with abundant natural resources. But, too often, they forget that many of the poor and weak nations once had plenty. They do not note that most of the poor peoples of the earth are poor mainly because their ancestors wasted the natural resources on which present generations must live.

Historical records of the last 6,000 years show that civilized man, with few exceptions, was never able to continue a progressive civilization in one locality for more than thirty to seventy generations (800 to 2,000 years). There were three notable exceptions: the Nile Valley, Mesopotamia, and the Indus Valley, which will be discussed later. Aside from these cradles of civilization, however, civilized man's dominance over his environment lasted only for a few generations. After a few centuries of growth and progress in a favorable environment, his civilizations declined, perished, or were forced to move to new land. The average life span was forty to sixty generations (1,000 to 1,500 years). In most cases, the more brilliant the civilization, the shorter was its progressive existence. These civilizations declined in the same geographical areas that had nurtured them, mainly because man himself despoiled or ruined the environments that helped him develop his civilizations.

How did civilized man despoil his favorable environment? He did it mainly by depleting or destroying the natural resources. He cut down or burned most of the usable timber from the forested hillsides and valleys. He overgrazed and denuded the grasslands that fed his livestock. He killed most of the wildlife and much of the fish and other water life. He permitted erosion to rob his farm land of its productive topsoil. He allowed eroded soil to clog the streams and fill his reservoirs, irrigation canals, and harbors with silt. In many cases, he used or wasted most of the easily mined metals or other needed minerals. Then his civilization declined amidst the despoilation of his own creation or he moved to new land. There have been from ten to thirty different civilizations that have followed this road to ruin (the number depending on who classifies the civilizations).

Of course, man seldom created a complete desert from a formerly fertile land. Sometimes he let the land revert to jungle. Usually, he left enough soil and vegetation to support a meager population of seminomadic herdsmen or peasant farmers. In some cases, he left enough to support a moderate city population. But in no case, to date, has he left enough of the basic natural resources to support a progressive and dynamic civilization.

Historians, in general, do not agree on the specific reasons why civilization has developed and flourished in some regions while lagging or failing to develop in others. A great variety of theories have been advanced. We will not attempt to discuss, or even name, all the theories. They are discussed fully and capably in other historical works.

Let us put it this way: civilization is a condition of mankind coacting with an

environment in such a way that progress results. Regardless of the forces that stimulate cultural progress, both civilization and the enjoyment of civilization rest on a *surplus* production by those who supply the necessities of life. By surplus production, we mean a surplus above the actual needs of the primary producers. A surplus production of food, clothing, shelter, and other necessities by farmers, herders, fishers, loggers, miners, hunters, trappers, and other primary producers is necessary before civilization can start. Furthermore, such surplus production must continue on a relatively stable basis if civilization is to keep advancing. The primary producers must supply a surplus before artisans, designers, engineers, scientists, philosophers, writers, artists, and other civilizers can exist and function. Few people ever advanced civilization while they had to produce their own food, clothing, and shelter directly from the earth.

More than a surplus production by the primary producers is necessary, however, for civilization to develop and progress. Artisans or manufacturers must learn to process many of the raw materials before they are usable by a civilized society. Trade and commerce must be developed to a certain extent before civilization can begin, and they are necessary for civilization to continue: the surplus of the primary producers has little value toward advancing civilization unless it is traded to the potential civilizers. And some form of relatively stable government is necessary for the manufacturers and traders to function.

There are also certain intangibles that enter into the development of civilization and affect its progress. Customs, religion, and many other things may help either to stimulate or to retard civilization. Then there is that elusive factor that, for lack of a better name, we shall call "the will to progress." Certain groups or nations of men are simply more aggressive than others; they advance civilization under conditions that seem similar to those of other people who stagnate or regress. We will not attempt to analyze fully the reasons for this aggressiveness. Arnold J. Toynbee, in *A Study of History,* with some plausibility offers his theory of "challenge and response" as a primary cause for the will to progress. Other historians and philosophers offer different theories. You may take your choice. But this will to progress probably depends on good food and good leadership more than on anything else.

All these intangibles and many other factors may play an important part in the development and advancement of civilization, but most of them are conditional--they are positive factors only under certain conditions. There is one requirement of civilization, however, that is not conditional. It is an absolute essential under all conditions. The primary producers must produce a *surplus.* Without such a surplus there can be no cities.

It is difficult to conceive of a civilization without cities. Granted that some of them are too big to be efficient, or healthful, or sane, but cities of reasonable size are necessary. They are the seats of government, of higher learning, of special training, of manufacturing and distribution, and of stimulation to many lines of creative work. Yet they cannot exist without a constant flow of food and raw materials coming in from the country.

Many people take this flow of surplus goods for granted. They think, "If a city grows, the farmers will automatically feed it." The reverse is more accurate. When the farms, forests, and grasslands produce a surplus, the cities automatically grow. When

the farmers, herders, woodsmen, and other primary producers fail to produce a surplus, cities wither and die.

The factors that determine the amount of surplus produced by the primary producers largely limit the status of any civilization. These factors are homely fundamentals: the fertility and extent of arable soil, the amount of rain infiltration into the soil, the extent and reproductive success of forests, the quantity and quality of grasslands, the abundance of beneficial wildlife, fish, and water life, the supply of usable water, the abundance of mineral fuels, metals, construction materials, and other deposits in the earth's crust. These are the natural resources with which the primary producers work. The quantity and quality of these resources largely determine the amount of surplus produced.

A common error has been to consider these resources as static. The proponents of the standard formula, "capital plus labor plus raw materials plus management multiplied by technology equals production," have nearly always considered raw materials as a constant. But they are not constant. Soil fertility, usable water, forests, grasslands, beneficial wildlife, and other resources have not remained a fixed item in any region. They have decreased in most areas occupied by civilized man. In many of the older countries they have almost disappeared. And with their decrease has nearly always come a decline in civilization.

We repeat: These are not the only factors which determine the status of any given civilization, but they are basic factors which largely limit any civilization.

The first civilizations of mankind were built on irrigated agriculture. This was not because the first farmers used irrigation to water their crops, nor because irrigation was necessary to produce a surplus of food. Primarily it was because the irrigated lands remained productive much longer than did the lands where rainfall furnished the water for crops. A secondary reason was probably the fact that farm production was more dependable on irrigated lands, where drought was not so likely to be catastrophic.

The durability of the land was not of such prime importance in the development of later civilizations. These inherited a substantial part of their civilizing activities from former civilizations, and were able to develop in a few centuries.

But it is a big step from primitive culture to civilization, if made without the aid of civilizing influences from others. The people who developed the first civilizations (in the Nile, Euphrates, and Indus valleys) probably had to farm the same lands for at least one thousand years before they could create a true civilization.

Man probably did his first farming in southwestern Asia, about eight thousand years ago. In this climate of moderate rainfall (fifteen to thirty inches a year), he found just the right amounts of rain and sunshine to make farming relatively easy. He planted his first crop of emmer, spelt, barley, millet, or wheat and waited around for a season to harvest it. This laid the foundation for civilization by enabling the farmer to grow a surplus of food. Thus he, or someone in his family, had leisure time for activities other than searching for food. It led to a division of labor and to the separation of skills between farmers and artisans.

We don't know where, when, or how farmers first learned the art and science of irrigation. Probably it was in some of the small valleys that were flooded annually. Possibly it was in the valleys of large rivers that overflowed regularly, such as the

Nile, Euphrates, and Indus. Man learned the art of irrigation long before he learned to write and read, probably before he had any form of stable government over a large area, and before he carried on extensive trade. In other words, he was an irrigation farmer several centuries before he was civilized.

Most historians agree that the first civilizations were developed in three regions: the Nile Valley, Mesopotamia, and the Indus Valley. All these valleys shared three common factors: (1) the soil was fertile, (2) the water supply was dependable because irrigation was used, and (3) the soil did not wash away because the land was relatively level and the rainfall was scant. All three of these conditions were important, but the third was most important.

The fertile soils and dependable water supply enabled farmers to produce a large surplus of food and insured a continuity of the food supply. Many people were freed to become artisans, indulge in trade, and practice the civilizing arts. The stability of the land made it possible for farmers to farm the same land for many generations. This gave the people an opportunity to settle down and build permanent homes. They were able to develop relatively stable governments and fairly stable channels of trade and commerce. This meant that they were eventually able to build cities.

These first civilizations will be discussed in more detail later. Not only were they the first civilizations of mankind, they were also the most durable, and their durability was due mainly to the durability of the land on which they were built.

Civilization spread from the irrigated valleys to other areas. In most cases, these other areas did not have the conditions that stabilized the Nile Valley, Mesopotamia, and the Indus Valley. The soil was fertile, but much of the land was sloping, and rainfall furnished the water for crops. When the rains came, they washed away the fertile topsoil from the sloping grainfields, deforested hillsides, and overgrazed grasslands. The land was often ruined for farming in a few generations. When this happened, the people had to move to new land or eke out an existence on impoverished land. These civilizations declined or perished in a few centuries, as they depleted or exhausted the lands on which they were built.

All across the continent of Asia and into Europe and North Africa, you find the seats of former leading civilizations that are now among the backward areas of the world. You need not search to find such areas: just call the roll of the ancients, and then look at the lands they lived on, as they are today. You will soon see what the man meant when he said that civilized man has left a desert in his footprints as he moved from place to place across the face of the earth.

Look at western Iran, where the Medes and the Persians prospered; look at northern Iraq, the former home of the Assyrians; look at Syria, Lebanon, Palestine, Algeria, and Tunisia, which once supported proud civilizations. Or take Crete, Greece, Italy, Sicily, and parts of Asia Minor as examples; these are the lands from whence our western civilization arose.

Let's not put the blame for the barrenness of these areas on the conquering hordes that repeatedly overran them. True, those conquerors often sacked and razed the cities, burned the villages, and slaughtered or drove off the people who populated them. But *while the soil and other resources that built the cities remained, the cities were usually rebuilt.* It was only after the land was depleted or exhausted that the fields became barren and the cities remained dead.

Many of the ancients will be discussed in more detail later in order to analyze the causes for their downfall and what happened to their lands. But the rise and fall of most of them can be described in one paragraph because the pattern is much the same for all.

Most of the progressive and dynamic civilizations of mankind started on new land--on land that had not been the center of a former civilization. Each civilization flourished and grew for a few centuries on the land that gave it birth. The people who evolved it became more and more civilized during this period of growth. Then they found that their native land would no longer support them, so they began to conquer and take the land of some of their neighbors. With the new land thus acquired, they held their gains in civilization for a few more centuries. After they reached their limits of conquest, their civilization began to decline. Eventually it was engulfed by the surrounding barbarians, and a dark age ensued. After that, a new civilization arose on new land among some of the semicivilized barbarians. Then the pattern was repeated. When history is stripped down to its fundamentals, this is the basic pattern for the rise, growth, and decline of past empires and civilizations. Of course, the details vary in the rise and fall of these ancients. Some of them were conquered by the semicivilized barbarians they had subdued and taught. Others were overwhelmed by barbarians from outside their sphere of influence. Some were conquered by more virile civilized peoples. Usually political corruption and economic maladjustment hastened the decline and fall of these ancient civilizations. Often, religion, moral decay, or poor leadership played a major role in the decline. But, with few exceptions, the decline did not come until they had despoiled the land that gave them food and supported them during their growth.

We know that the decline of all past civilizations, or any given civilization, cannot be attributed to one specific cause. Civilized men lead a complicated existence, and their civilizations are complex affairs. You can't rightfully use any yardstick of spiritual, intellectual, or biological development to measure accurately their progress. Nor can you use any particular feature of physical environment as a barometer to gauge accurately their rise and fall. But, as has been pointed out, one factor definitely limits the status of any civilized society--the amount of surplus raw materials produced by the primary producers. Furthermore, this surplus is determined, to a great extent, by the abundance and accessibility of natural resources, and especially by the productivity of the farm, range, and forest land.

The decline of any given civilization has been ascribed by historians to various causes or combinations of causes. Among the causative factors most frequently mentioned are war, change of climate, moral decay, political corruption, economic maladjustment, deterioration of the race, and poor leadership. These and many other factors have doubtless had significant influence on the decline of most civilizations. But it is doubtful that any or all of them were the primary and basic causes for the permanent decline of civilization in any region.

So many civilizations have survived and advanced after repeated wars that it is not feasible to claim that such violence, in itself, is a primary cause for the decline of civilization. Many of the great civilizing peoples, the Babylonians, Greeks, and Romans, for example, were at war almost constantly throughout the period of their progressive growth.

It is true that most of the extinct civilizations succumbed at the time they lost wars and had their cities destroyed. It is also true that conquest caused a temporary decline of civilization in many regions. Such a decline was especially notable where the conquerors maintained their seats of government in distant lands and shipped most of the surplus production out of the conquered regions. But the decline of civilization because of war or conquest was never permanent in any region that still had the natural resources to build new cities and support a continuing civilization.

For example, in the Nile Valley and Mesopotamia, civilization was destroyed and dark ages ensued at least once, while temporary decline came several times, as a result of conquest. But new, progressive civilizations were built in these regions after each period of decline as long as the resources to support civilization were still there.

War, especially large-scale war of the twentieth-century type, uses up natural resources at a great rate. And it may prevent a people from practicing true conservation. In these ways, war may contribute to resource destruction and the ultimate decline of civilization. But war has not always caused resource destruction. In some cases, it has actually led to conservation by limiting the population of a region and preventing intensive use of the land. This happened to parts of the Near East during ancient times and to Western Europe in the Middle Ages. War may be an important contributing factor in the decline of civilization, but it has seldom, if ever, been the basic cause for the permanent decline of civilization in any region.

The "change of climate" theory has been largely disproved by modern science and meteorology. It will be discussed in more detail in a later chapter.

"Moral decay" and "political corruption" have been prominent features of most declining civilizations. They have doubtless been important contributing factors in the decline of some. Yet there is a question whether these were not results rather than causes of decline in most cases.

Many civilizations have continued to progress long after moral decay and political corruption were obvious. (Several of the European nations of early modern times furnish good examples.) These social diseases have a way of curing themselves, if the physical environment remains favorable. Sometimes the cure is effected through the conquest of the decadent people by a more virile people, and the civilization is perpetuated by the conquerors. That is essentially what happened to North Africa with Rome's conquest of Carthage, and it happened several times in Mesopotamia and in some other regions.

"Economic maladjustment" has nearly always been prevalent in declining civilizations. In some cases, an almost complete breakdown of the economic system preceded the final collapse of the civilization. Again, it is doubtful that this was more of a cause than an effect. The point is arguable in almost any given situation. For example, material wealth was concentrated in the hands of a few while the masses were generally poverty stricken in most dying civilizations. But this condition developed to an alarming extent in some growing civilizations and was corrected. Revolution, taxes, or other means were found to redistribute the wealth, and civilization advanced to greater heights than ever. This happened in Athens from the time of Solon to Cleisthenes, in the sixth century B.C., and it happened in most nations of Western Europe during the late Middle Ages and early modern times.

Of course, concentration of the land and other resources in the hands of a few may

hasten resource destruction and thus contribute indirectly to the decline of civilization. There are also many other forms of economic maladjustment that may influence the ultimate decline of civilization, but these things are, at most, only contributing factors.

"Deterioration of the race" as a cause for the decline of civilization has little scientific basis. Random mating usually insures an average quality of population. Where deterioration seems to exist, it is usually a result of improper nourishment. This has frequently happened where the productivity of the soil deteriorated, or where overpopulation forced an inadequate diet. Most of the depleted lands or overpopulated regions of the present bear out this contention.

"Poor leadership" as a cause for decline of civilization has some plausibility. It might seriously affect the will to progress, lead to destructive wars or economic maladjustment, or seriously affect the moral fiber of a people. Yet, because of the time element, it is questionable whether poor leadership has ever led to the demise of any civilization. Take the Roman Empire, for example. When such incompetents as Caligula, Claudius, Nero, Galba, Otho, and Vitellius were successive emperors for a period of thirty-two years, civilization held its own, and the "silver age" of Rome followed.

Civilizations do not die in a few decades. Stupid, incompetent, or careless leaders seldom last long: competition usually takes care of the situation. It is true that poor leaders may retard civilization or cause a temporary decline, but in the long run they do not stop it from going up, and they do not cause permanent decline, provided other factors are favorable for advancement.

Only sketchy examples have been given to support the above arguments. The reader can doubtless supply many other examples of his own. The purpose of this discussion is not to prove that these factors were of no consequence in the decline of past civilizations, but to show that they were not the fundamental causes of decline. The fundamental cause for the decline of civilization in most areas was deterioration of the natural-resource base on which civilization rested.

Since the first historical records were kept, and long before, people have waged war against their neighbors to get more land and more of the things it produced. The pattern was set when the first clan or tribe of savages decided that their neighbors had better fishing or hunting grounds. It has continued through the ages. The future looks little brighter.

The mass migrations of man over the face of the earth were mainly to obtain richer natural resources. Regardless of whether you call such migrations colonization, conquest, or emigration, the objectives were much the same. The migrators were not merely seeking a change of scenery. Sometimes they were fleeing before an enemy who had dispossessed them. More often they were trying to dispossess a neighbor who had richer land or more wealth.

When barbarians overran civilized communities, they were usually seeking superficial wealth that the civilized societies had extracted from nature, and they usually thought of it as conquest. For example, the barbarous Aryans who invaded the civilized Indus Valley around 1700 B.C. simply called war "a desire for more cattle." The Hyksos conquered Egypt and the Kassites overran Mesopotamia about the same time because they "desired" the rich cultivated fields and cities of the Egyptians and Babylonians. The Achaeans and Dorians overran Greece and Crete some six or eight

centuries later because they "desired" the rich booty of the civilized Minoans and Mycenaeans. The Assyrians, and later the Medes and Persians, moved into Mesopotamia for like reasons. The Goths, Franks, Vandals, and others had similar motives for occupying the Roman Empire during the fifth century A.D., just as the Huns and Mongols had for overrunning Southwest Asia and Eastern and Central Europe during the Middle Ages. These are just a few of the more familiar examples. Countless others can be found by reading a few pages of almost any history book.

The record of civilized peoples is even worse than that of barbarians, largely because they usually bad better implements of war. The civilized societies, however, were mainly seeking land and the raw materials it produced. And they generally called it "colonization" when they took land away from more primitive peoples, although sometimes they frankly called it conquest. Regardless of what they called it, the results were much the same. And, again, you find the history books filled with the gory details.

The Babylonians and Egyptians were not always on the losing side--they took the land and enslaved the inhabitants of all areas around them when they could. The ancient Minoans, Phoenicians, and Greeks took to the sea to find more fertile lands that they could take away from less civilized peoples. The Romans conquered most of the known world in "self-defense" and held it under subjection for centuries. More recently, the Western Europeans "colonized" a great part of four continents and slaughtered or exploited the native inhabitants, while American colonizers "settled" a vast expanse of the rich North American continent. These civilized peoples also "desired more cattle," and they desired many other forms of wealth that could best be acquired by seizing new land and its rich resources.

Much of this colonization, migration, and conquest was brought on by the rapidly increasing populations of the colonizers, migrators, and conquerors. They simply multiplied so rapidly that their homelands were inadequate for their support. War served two purposes: it gave the victors more land, and it decreased the population of both the victors and the vanquished. But let's not put all the blame on the increase of population. A lot of the overcrowding was caused by diminishing resources. The waste and depletion of natural resources was probably the major cause for overpopulation more often than was a high birth rate.

Man is now entering a new era--we should probably say that he has already entered it. Most of the world is civilized today, except for a few tropical and subpolar regions. Furthermore, most areas are fully settled. Future conquerors or colonizers will have to exterminate some of their neighbors if they want to gain control of any great quantity of new resources. The pattern of the past--use up the natural resources and move to new land--is no longer an adequate solution. The time has arrived when all peoples must take stock of their resources and plan their future accordingly. Conservation has become a necessity, not just a desirable objective. This is true for the United States as well as for the rest of the world.

It is not necessary to destroy natural resources in order to use them. People can conserve most resources while still obtaining maximum benefits from them. All the renewable resources--soils, forests, grasslands, water, and wildlife--will produce more under well-managed programs of conservation than they will produce if wantonly exploited. And generation after generation, their production will continue to rise. With

improving technology and true conservation, the remaining resources of the world should continue to support a moderately increasing population for thousands of years to come.

Many American farmers, stockmen, and foresters have recently shown that it is possible to increase production greatly while conserving and improving their farm lands, grasslands, and forests. Furthermore, some of the ancients and the moderns in other regions of the world have proved the same thing. Unfortunately, too few have practiced true conservation. The great majority have always exploited these resources without thought for the morrow. And the conservation efforts of those who did took to the future were nearly always too little and too late.

The nonrenewable resources--the minerals, metals, petroleum, and other deposits in the earth's crust--present a different problem. These things will not grow and multiply with proper treatment. But they are not the basic resources that support life, and substitutes can be found for most of them. The main consideration with respect to these resources is to avoid waste until adequate substitutes have been developed by modern technology.

The wealth and power of the United States, like that of most preceding and contemporary nations, come mainly from our rich inheritance of natural resources. While it is true that our democratic form of government and competitive system have greatly stimulated technological advancement and mass production, these things would not have been possible except for our abundant resources.

It was the abundance and richness of our farm lands, grasslands, forests, wildlife, and water resources that brought our initial wealth. It was the abundance of coal, iron ore, petroleum, and other mineral resources that made our great industrial development possible. These are the things that still sustain us. The wealth and power of this great nation will decline, as they have in all past empires and civilizations, if and when these resources are depleted to the extent that they can no longer supply our needs.

Most of our natural resources have already been depleted to an alarming extent. Modern technology and enterprise have made it possible for us both to develop and to exploit these resources faster than any other people in history. The United States is now approaching the stage in resource depletion at which many of the past empires and civilizations started to decline.

This nation can no longer afford the luxury of wasteful exploitation. It is possible that it may not even be able to afford the luxury of a free democracy if resource destruction continues. Other peoples have accepted a dictatorship as their resources were depleted, hoping that a strong leader could regain for them a lost standard of living.

When resources become so depleted that there is not enough wealth for all, the weak usually surrender their liberty to the strong. Often the masses follow a demagogue who promises to take wealth from the rich and give it to the poor. Sometimes they submit to a dictator who promises to lead them to victory over neighboring lands. Sometimes they fight civil wars. Some of the weak nations quickly submit to conquest by neighboring states. The end to individual liberty is eventually the same.

True democracy cannot survive in a country where a large part of the people are hungry. The inalienable rights to life, liberty, and the pursuit of happiness cannot be

enjoyed by a people unless there is enough food, clothing, and shelter for all. In other words, we must have resources sufficient to maintain a reasonably high standard of living in order to have true democracy.

Within recent years, a nationwide conservation program has been started in the United States. Conservation is spreading to many parts of the world. In a few small areas, adequate conservation programs already exist. But over most of the world, and most of the United States, exploitation is still the rule. Only a fractional part of the productive land is being properly conserved and improved for future use.

The question is, Will our modern civilization begin to practice true and full conservation in time? Or will our conservation efforts be like those of all the ancients, too little and too late?

2. THE NILE VALLEY

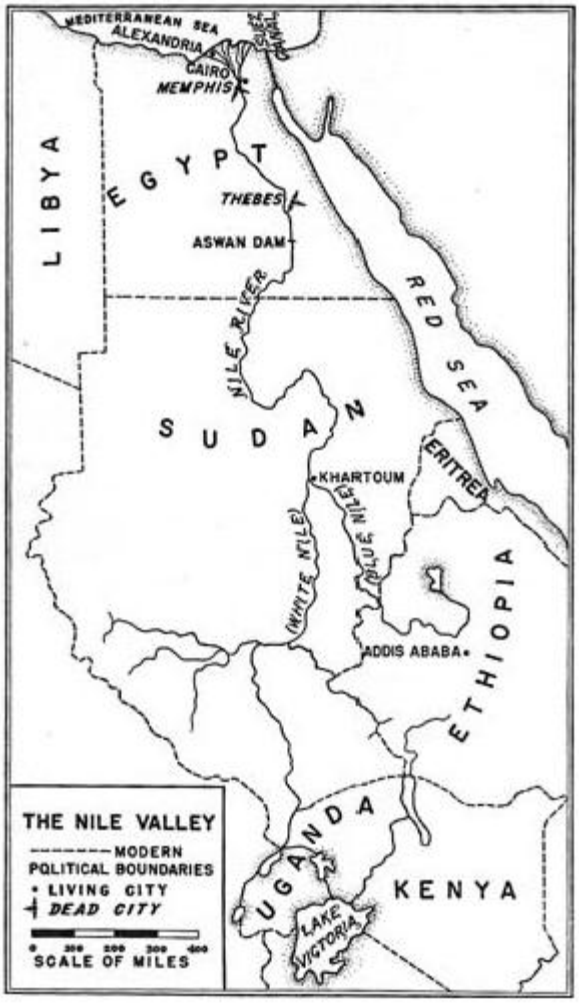
IN THE midst of the broad, yellow deserts of North Africa lies the narrow, green valley of the Nile. This vine of life stretching across the dead waste of the Sahara, its roots sunk in the waters and soils of distant lands, has played a great role in the history of mankind. The waters of this great river have nourished more than six thousand years of civilization, and the and climate has preserved many of the records from decay.

Here, in the valley of the Nile, is one of the notable exceptions to the rule that civilized men can prosper in a given area for only thirty to seventy generations. The original Egyptians prospered and developed their civilization for more than a hundred generations, and when at last they submitted to conquest, their land still served as a principal granary to help enrich the conquerors for more than two thousand additional years. The durability of the land, which made these thousands of years of prosperity possible, was due mainly to the unique features of the valley.

The first Egyptian farmers watched the water of the Nile rise each summer--rich brown water pouring down from the Abyssinian Alps and the highlands of Central Africa 1,500 miles away. The flood was gulped by Egypt's cracked, thirsty land. When the waters withdrew, the farmers cast their seed in the mud. Sometimes the flood passed away too quickly, crops failed, and thousands died of starvation. For this problem, a partial solution was found in dikes--walls of earth surrounding each field, imprisoning the water until the land had drunk its fill. After weeks of imprisonment, during which the soil became mud and the precious sediments and organic matter from other lands settled on the fields, holes were knocked in the dikes. The surplus water returned to the river, and the sturdy farmers went to work.

Centuries passed; population grew. The need for more cropland brought the invention of the waterwheel and the canal to lift and carry the Nile to higher and more distant fields. With flood and basin irrigation, one crop was grown each year, except near the riverbank, where the waterwheel made two crops possible. The land rested between harvest and flood, for there is little or no rain in most of Egypt.

Egypt is truly the "gift of the Nile." The delta and the narrow flood plain are deposits laid down by this mighty river through geologic time. Egypt is also the gift of Abyssinia, Kenya, Tanganyika, Uganda, Congo, and Sudan--it is from these areas that came the water, the silt, and the humus which made Egypt. The silt that enriched the Nile Valley came mainly from the Abyssinian highlands. There, nature each summer assaults the rugged and inhospitable mountains with lightning and thunderstorms. The wet monsoon winds roll in from the Indian Ocean. They soar up the alpine slopes into the chill of the peaks, where condensation wrings the clouds dry and the rain descends in torrents, washing off the minerals which heat and cold, rhizome and root, and acid and decay have loosened from the lockers of the rocks.



This silt from the Blue Nile and humus largely from the jungle and swampy sources of the White Nile were laid on Egypt in a thin annual layer. The records show that in the first thousand years after Christ, about fifty inches of silt were deposited on the flood plain. That is an average of one-twentieth of an inch per year--not much, but enough. This thin skin of new soil was the secret of Egypt's long and productive career. If a great amount of silt had been brought to Egypt, the irrigation canals would have become hopelessly choked, the flood plain would have been built so high that flooding would have frequently failed to occur, and the difficulty of irrigation would have kept hundreds of thousands of acres out of production. (These disasters happened in Mesopotamia, which will be considered later.) The thin silt deposit was ample to replace the minerals harvested in crops. Humus cannot accumulate in such a warm climate; given the moisture of irrigation it decays rapidly, is converted into living crops, or is oxidized. Thus an annual deposit of humus by the Nile was a near perfect solution to the problem of supplying organic matter.

It was the superlative productivity and durability of the soil which made the first

Egyptian civilization possible. Surplus food was siphoned off from the farmers through taxes, rents, and trade. This surplus fed the slaves, artisans, scribes, priests, merchants, engineers, nobles, and all who devoted time and energy to building the culture of the country. Considering the limited variety of natural resources available and the embryonic status of the sciences, that culture was a remarkable achievement.

The Egyptians probably had no outside help in developing their civilization. It is likely that they were irrigation farmers at least a thousand years before they began using hieroglyphic symbols to keep records, and farmers for many centuries before they built any type of permanent buildings or other structures. If their land had not been durable, they would probably have remained a seminomadic people with a primitive culture, practicing a shifting agriculture as many of the primitive peoples in Central Africa do today.

Stone Age men probably lived in the Nile Valley for more than twenty thousand years. It was not until after 6000 B.C. (probably around 5500 B.C.), however, that the Egyptians became farmers. Several centuries later, they began to build towns and cities and emerged as what we call a civilized people. By 4000 B.C., they were farming the valley on an extensive scale and had developed a form of tribal government. By 3500 B.C., they had a centralized government with their capital at Memphis. By 2800 B.C., their civilization had advanced to such a stage that they were able to build those colossal structures that we call the great pyramids. By 2000 B.C., they had an old and advanced civilization and were carrying on extensive trade with Crete, Palestine, Phoenicia, and Syria.

During the first twenty-five hundred years of their civilization, the Egyptians were relatively undisturbed by external wars. They fought at times with the desert peoples to the east and west and with the Nubians to the south, but apparently their territory was never extensively invaded or conquered. In this they were fortunate; the deserts and the mountain wilderness gave them a type of protection that few of the ancients enjoyed.

The Hyksos nomads from Asia invaded Egypt around 1700 B.C. They conquered all the lower Nile Valley and ruled the land as the "Shepherd kings" for about a century. This should have ended Egyptian civilization, just as barbarian conquests ended many other civilizations. Toynbee finds it perplexing to understand why the Egyptian civilization was able to recover from this blow and have another thousand years of prosperity and progress. The answer seems simple: the Egyptians were able to absorb or drive out the Hyksos and continue their civilization because their land was still fertile and productive.

After 1600 B.C., Egyptian civilization became more virile than ever in most respects. Having sensed the futility of isolationism, the Egyptians set out to conquer all the lands around them. They ruled most of Palestine, Lebanon, and Syria for some four or five centuries. At times, they pushed the boundaries of their empire as far east as the Euphrates. But like other conquerors and would-be conquerors, they had reverses. The Libyans from the western desert, then the Ethiopians from the south, defeated them and ruled their land for relatively short periods. But the Egyptians recovered from these conquests, just as they had recovered from the Hyksos conquest. These Libyan and Ethiopian rulers were soon civilized and absorbed by the superior Egyptian culture, and the Egyptians re-entered the arena of international combat.

They were able to do this mainly because they still had a dependable food supply in their homeland. Then, as now, food was the first measure of strength in a nation.
In the 7th century B.C., Egypt was conquered and ruled for a period by the Assyrians. The Assyrians did not move their capital to the Nile Valley as had all previous conquerors. They exacted heavy tribute, in grain and other wealth, to support their government at Nineveh. This was the beginning of the end of progressive Egyptian civilization. There was a brief revival when the Assyrian domination was overthrown. Then, about 525 B.C., the Persian conquest ended Egyptian independence; her four-thousand-year-old civilization was no longer a potent factor in world history.
From the time of the Persian conquest until the twentieth century, the Nile Valley has been ruled mainly by foreign races. The surplus products of the land have helped to develop or support, in turn, the cultures of the Persians, Greeks, Romans, Arabs, Turks, and British. From the lifestream of the green valley, each of these conquerors drew sustenance which first increased the strength of their empires and later prolonged their vigor during the years of decline.
We may date the end of the original Egyptian civilization with the Persian conquest, but that was not the end of civilization in the Nile Valley. During a greater part of the twenty five centuries that have ensued, the valley was ruled by empires with their seats in distant lands. During these times, the surplus products went out of the land, and poverty and decadence resulted in the Nile Valley.
But the valley was not always relegated to the backwaters of civilization. There were periods when the rulers had their seats of government along the banks of the Nile, and during these periods the region was one of the foremost cultural centers of the world, even though the culture was largely a transplanted foreign culture.
After the breaking up of Alexander the Great's empire (323 B.C.), the Macedonian Ptolemies maintained their capital at Alexandria for about three centuries. They ruled the Nile Valley and, at times, substantial parts of the Near East from there. During this period, Egypt prospered and Alexandria became the foremost cultural center of the Mediterranean world. It was primarily a Greek culture, but it was supported by the rich soil of the Nile Valley.* (*For our purposes, we do not distinguish between a transplanted culture and a native culture. Both are supported by the land on which they subsist. For that matter, you could rightfully call modern American civilization a transplanted culture from Europe.)
With the death of Cleopatra (30 B.C.), Egypt became a Roman colony and, like most other Roman colonies, was exploited for the benefit of Rome. Naturally, there was a regression of civilization because a great part of the surplus products were shipped out of the land. Alexandria remained a great city during this time, mainly because it was the principal port through which Roman tribute was shipped out. It took a fairly large city to handle the surplus grain and goods that the Romans exported.
After the fall of Rome, the Byzantine Empire took over exploitation of Egypt. The Sassanian Persians contested the Byzantines' right to the riches of this valley during the sixth and early seventh centuries, but the result was the same for the people who lived along the banks of the Nile. In the seventh century, the Moslem Arabs came as conquerors. They ruled the land from their capitals in Syria and Mesopotamia for

about two centuries, until the Fatimid caliphs declared Egypt an independent country. Then began the last period of prosperous and progressive civilization in the Nile Valley.

From the ninth to the fifteenth centuries, Egypt again had its seat of government along the banks of the Nile. The Arabs built the city of Cairo near the site of ancient Memphis. The Fatimid caliphs and the Mameluke Turks ruled not only the valley but, at times, most of North Africa and parts of the Near East from Cairo for more than six centuries. During this time, there was a great resurgence of civilization. This might also be called a transplanted culture, but it was supported mainly by the rich soil of the Nile Valley. This civilization, along with the rest of Islam, was the most advanced in the world at that time. And Cairo was one of the richest and most opulent cities of the world.

Early in the sixteenth century, the Ottoman Turks gained control of Egypt and ruled it from their capitals in Asia Minor and Constantinople. There was a brief period of Egyptian independence as the Ottoman's power declined; then the British assumed a protectorate over the land and continued the exploitation. Of course, civilization regressed during these periods.

During the twentieth century, Egypt again became an independent country. Will there be another resurgence of Egyptian civilization? This is questionable. The soil of the Nile Valley is still fertile. It now feeds more people than ever before in history. But there is grave doubt that this land will retain its fabulous productivity. Man has finally become civilized enough--he has acquired sufficient engineering skill and egotism--to start the destruction of this almost indestructible land.

Two things are now happening in the valley that did not happen during ancient or medieval times: civilized man has occupied the headwaters of the Nile with his plows, axes, and herds of livestock, and modern engineers are trying to control the water of the Nile with large dams. Both are having their effects. The ultimate results could be disastrous.

In 1902, British engineers supervised the construction of the Aswan Dam a short distance below the first cataract of the Nile. Since then, this dam has been enlarged and other dams have been constructed on the lower Nile and on both the Blue and White Niles. These dams were built to serve two main purposes: to stop the annual flooding of the lower Nile Valley, and to make year-round irrigation possible throughout most of the lower valley. Both of these seem commendable objectives. Irrigation with well-placed canals is more dependable than flood irrigation; this is especially true during drought years when the floodwaters fail to cover all the farm land. Year-round irrigation makes it possible to grow two or more crops each year in this semitropical climate.

But that is just one side of the story. The dams that prevent flooding of the valley also prevent the floodwaters from laying down that twentieth of an inch of silt and humus each year. Most of these materials now settle to the bottom of the reservoirs. Thus, since 1902, the Nile Valley is no longer receiving the annual replenishment of minerals and humus that made it so productive for more than six thousand years. We hardly need to point out the effect on soil fertility of harvesting two or three crops each year, especially when there is no replenishment of soil nutrients.

Egyptian farmers soon found that yields were declining rapidly under this system of

management. They tried to compensate for their loss by liberal applications of chemical fertilizers. They actually increased crop yields by this means, but while they were doing so, the humus supply in the soil became less and less. They hastened the depletion of humus by growing cotton on a large scale, for cotton leaves almost no organic matter in the soil.

The problem of farming land that contains little or no organic matter will be discussed more fully in the last chapter of this book. It is sufficient here to say that modern soil scientists have grave doubts whether any land can be kept permanently productive without a regular replacement of soil organic matter because the land becomes increasingly difficult to till, especially if the soil is silt or clay as it is in most of the Nile Valley, and crops gradually cease to respond properly to the use of chemical fertilizers. Furthermore, the perennial irrigation has created serious problems of waterlogging and accumulation of toxic salts in the soil.

In other words, modern British and Egyptians have greatly increased production in the valley for two or three generations, but in doing so they have possibly started the ultimate destruction of this most durable home for civilized man. Production will almost certainly decline unless Egyptian farmers adopt a system of farming that will provide for a regular replenishment of the organic matter that the White Nile used to give to the lower Nile Valley.

Upstream, at the headwaters of the Nile, we can see how civilized man's occupation of those regions may affect the lower Nile Valley. Civilized or semicivilized men have lived in Ethiopia for three thousand years or longer. But apparently they were never very numerous in ancient times and did not occupy the highlands where the Blue Nile rises. That region was not occupied extensively by civilized men until the latter part of the nineteenth century. This means that deforestation was not extensive, and that man-induced erosion was not excessive until the last few decades. Vast areas of the Abyssinian mountains, the headwaters of the Blue Nile, are still relatively undisturbed. But these areas are rapidly succumbing to the axes and plows of civilized men. As a consequence, the silt load of the Blue Nile has increased greatly during recent years and the amount of runoff from these mountains has increased. This means that without the dams on the Blue Nile and the lower Nile, the flood crests would be higher and the amount of silt deposited on the land would be greater. The floods and silt probably would soon destroy the agricultural value of the land if it were not for the dams that hold them in check.

The headwaters of the White Nile have been subjected to civilized man's exploitation for even a shorter period than those of the Blue Nile. Rainfall is less intense over most of this area than in the Abyssinian mountains. In ancient times, the White Nile never contributed much of the floodwater and silt that the lower Nile received. But during the twentieth century civilized man has begun to make his mark on the lands that feed the White Nile. Large areas have been placed in cultivation. Still larger areas have been overgrazed by herds of livestock. Soil erosion is accelerating rapidly. Whereas the White Nile used to have a fairly steady flow and carried little silt, now the flow is becoming seasonal and the silt load is increasing. The increased erosion from the headwaters of the Nile tributaries will soon fill the man-made reservoirs with silt, and the reservoirs will become ineffective if present land-use practices continue. In fact, the Aswan reservoir has already filled with silt to

some extent. This is one of the reasons why the dam has been enlarged three times since its construction, why the dams were built upstream on the Blue and White Niles. These reservoirs are now threatened with destruction by the water and silt that they are supposed to control. They may be effective for a few generations, but their lifetime, compared to the seven thousand years of nonreservoir irrigation in Egypt, will be very short; that is, if present land-use practices in the headwaters are continued.

The Nile Valley furnished a stable home for civilized man for more than six thousand years (longer than any other large area of the world has retained its productivity under the occupancy of civilized man) . Man finally became civilized enough to start destruction of this stable land. He upset the natural balance with his axes, plows, herds, dams, and chemicals. The region is now threatened with going the way that most other regions have gone.

It is not necessary for civilized man to destroy this land in order to live there, but he must change his ways if he wishes to continue to prosper in this region. And his solution of the problem must include corrective measures in the headwater lands of Ethiopia, Sudan, and Central Africa.

3. MESOPOTAMIA

IF You measure the comparative importance of Iraq and the United States on the basis of present wealth and population or their contributions to twentieth-century civilization, Iraq does not seem important. But if you compare lower Mesopotamia to the United States on the basis of total contributions to civilization, then the United States becomes the less important of the two.

Mesopotamia has probably contributed more to the advancement of civilization than any other area of like size in the world. Excepting the Nile Valley, its land has been more durable than any other extensive area for which we have records. A few million acres of fertile land there have nurtured ruling races for a longer time than has a comparable area in any other region. The culture and science developed by people living there have spread over the entire world.

It was not the superiority of the people who lived in the twin valleys that gave Mesopotamia such a brilliant chapter in world history. Dozens of different tribes and races of men have lived and ruled there. From the beginning of historical records, this area was a battleground between nomad herdsmen and settled farmers, between Aryans and Semites, between Orientals and Occidentals.

It was the favorable environment for early man that made this region significant. Yet the chief resources were the fertile valley lands and the waters of the Tigris and Euphrates rivers. These constituted, in the main, the natural wealth that made Mesopotamia a cradle of civilization. The relative stability of these resources was largely responsible for the durability of the land as a home for civilized men.

Probably no other area on the face of the earth, with the possible exceptions of Syria and Palestine, has been overrun by conquering hordes as many times as Mesopotamia. From the earliest records until fairly recent times, the valley lands of the Tigris and Euphrates were considered rich spoils of war. To enumerate the conquerors and would-be conquerors would be almost like calling the roll of ancient and medieval tribes of Central and Western Asia, Southeastern Europe, and Northeastern Africa. They came, they saw the fertile soil and the advanced civilization it supported, and they conquered--if they could. Some of the would-be conquerors were beaten off. Others ravaged the country and left. But many of them founded new empires with Mesopotamia as the core. Conquering nomads settled down to become farmers, artisans, and businessmen. Forsaking the hard, dangerous life of the steppes, they softened, neglected the ways of war, and, in turn, were conquered.

The valley lands of these two rivers had, and have to this day, fertile soils. Even more important than fertility, however, were the almost level topography and the scant rainfall. The topsoil did not wash away as it does on sloping land, and the minerals did not leach deep into the soil as they do under heavy rainfall. Hence the fertility could be maintained indefinitely by the use of fairly simple soil-management practices.

The big problem in Mesopotamia has not been soil erosion, although in some sections soil blowing has been severe, but how to furnish water to the dry earth so that its fertility could be used by crops. There was never enough rainfall to support a general agriculture without the irrigation furnished by the Tigris and Euphrates. But both rivers carried a large load of silt in their water.

Early in history, the Armenian hills, where these rivers rise, were deforested and overgrazed. Erosion proceeded to strip off the soil and pour it into the streams which

carried it hundred of miles southeastward.* The silt, unless it was removed, soon filled the irrigation ditches. (*The concentration of silt in stream water under such conditions may reach fantastic proportions. The Rio Puerco in New Mexico has shown a proportion of forty-two cubic inches of sediment to fifty-eight cubic inches of water. This is an extreme case, but it indicates what can happen when headwater hills are denuded of vegetation and subjected to thunderstorms.)

Keeping the irrigation ditches open was the chief conservation problem of all peoples who lived in the Mesopotamian flood plains. The people who prospered and advanced civilization usually solved this problem by slave labor. Occasionally, the country was conquered by barbarians who neglected the silt in the irrigation canals. When this happened, civilization regressed. But the barbarian influences seldom lasted long. They were usually modified by superior native culture, and the irrigation system was reinstituted.

Mesopotamia was not so fortunate as Egypt, for the Nile carried only a fraction as much silt as the twin rivers. The problem of a clogged irrigation system never perplexed the ancient Egyptians as it did the Mesopotamians. Egypt's source of food was never seriously threatened. Mesopotamia's food source was subject to quick breakdown through all her recorded history. Time and time again, mass starvation came to the eastern arm of the Fertile Crescent. Today, Egypt feeds more people than ever before; Mesopotamia feeds less than 25 per cent of its onetime population.

By 4000 B.C., or earlier, the Sumerians had several city-states in the lower valley of the Euphrates. The Sumerians were a non-Semitic people of undetermined origin who are credited with being the main civilizers of the region. The Semitic Akkadians occupied the central valleys to the northwest when history dawned in the area. The Tigris and Euphrates rivers emptied separately into the Persian Gulf, which extended about 130 miles farther up the valley than it does today.

BY 3500 B.C., the Sumerians had extensive irrigation works branching out from the Euphrates. The Akkadians were also irrigation farmers. We don't know how long the Mesopotamian irrigation works had been in operation when historical records first point them out, but it is almost a certainty that they were started by 4500 B.C., and probably several centuries before that.

For at least twenty centuries, the Sumerians and Akkadians attended to the job of keeping their irrigation ditches free of silt, and apparently succeeded. Perhaps they had much less silt to deal with than the civilizations that followed theirs. The Armenian hills may still have been well covered with forest and grass, and forests and grasslands do not give up much silt to the waters that run off them.

The Sumerians never established a unified empire; their civilization remained one of city-states. In the twenty-fourth century B.C., Sargon I of Akkad conquered and unified most of the city-states of Sumer and Akkad. He set up what was probably the first in a long series of empires that had the rich land of Mesopotamia as the core. He traveled as far west as the shores of the Mediterranean with his armies.

Some three hundred years later, the Elamites, from the Karun Valley to the northeast, came as conquerors and ruled most of the area for a few generations. Then came the Amorites, a Semitic tribe from the steppes and desert to the west. They built their capital at Babylon, and soon conquered the entire region to establish the first Babylonian Empire.

Hammurabi of Babylon (about the eighteenth century B.C.) left rather extensive records. These give us the first clear picture of Mesopotamia. Under Babylonian rule, the valley lands were irrigated more extensively than before. A vast network of waterways laced the flat valleys. The development of these irrigation works was a remarkable achievement of mind and muscle. The fertile waters were controlled, and floods were routed by dams and man-made channels away from the cities and farms, more successfully, perhaps, than our army engineers now handle the Mississippi. The main irrigation canals were lined with burnt bricks and the joints sealed with asphalt. This irrigation system was expanded until at least ten thousand square miles were in crops and around fifteen to twenty million people were eating the produce.

As in the Nile Valley, the superb productivity of the land enabled farmers to grow a large surplus of food. Millions of people were released from the fields to engage in industry, trade, and cultural work. Out of this system arose a civilization of numerous cities with paved streets, magnificent palaces and temples, artwork, cuneiform writing, mathematics, the calendar, astronomy, a famous code of laws, and many other evidences of progress. Christopher Dawson, in 1922, even went so far as to say: "In all essentials Babylonia, in the time of Hammurabi, had reached a pitch of material civilization which has never since been surpassed in Asia."* *(*Enquiries into Religion and Culture,* 107.)

In the sixteenth century B.C., the barbarian Kassites came from the steppes and hills to the northeast to conquer Babylonia. A dark age ensued that lasted some five centuries. Then the Assyrians came down from Nineveh, on the upper Tigris, and annexed lower Mesopotamia to their empire. The Assyrians had already absorbed much of the culture of Babylonia and Egypt, but being on the outskirts of civilization, in constant contact with barbarians, they had remained a vigorous, cruel, and warlike people. Like most other conquerors, they found the resources of their homeland inadequate to support their growing population, so the rich land of lower Mesopotamia was very inviting. Eventually they conquered and imposed their rule over all of the Near East; at times they even exacted tribute from Egypt.

For about five hundred years, the Assyrians dominated Mesopotamia and all surrounding territory, but they were constantly at war to keep the subject peoples under control. Around 700 B.C., Sennacherib of Assyria sacked and burned a rebellious Babylon. He killed or carried off as slaves practically all the inhabitants and left the city a pile of rubble and ashes. His son started the rebuilding of Babylon, however, in less than twenty years, and soon it was again a thriving metropolis.

The Assyrians finally fell before the combined onslaughts of the Babylonians and the barbarian Medes. Nineveh, which had been a city Of 300,000 people at its zenith, was razed, and the Assyrians disappeared from the pages of history. Nineveh was never rebuilt, nor did any near-by city take its place. There were no broad stretches of flat valley land near Nineveh. The city originally depended on relatively small areas of irrigated land and large areas of grazing land. During its rich and populous period, it depended mainly on spoils and tribute from conquered peoples. When Assyria's military power was broken, Nineveh did not have the resources to stage a comeback. Hence, it passed into oblivion.

When Assyria was overthrown, Babylon again became the capital of an extensive empire. During the reign of Nebuchadnezzar (about 600 to 560 B.C.), Babylonian

civilization reached a grandeur probably equal to that of Hammurabi's time. It was then that the Hanging Gardens and many other magnificent structures were built, the ruins of which have been excavated in modern times.

Then came the barbarian Persians from the east to conquer all of Mesopotamia (around 540 B.C.). They did not move their capital to Mesopotamia, as had most conquerors before them, but they did use the rich farm land there as the core for another empire.

The Persian rule of Mesopotamia lasted about two hundred years; then Alexander the Great came from across the Hellespont to conquer the region. Even he must have decided that this was a fairer country than his native Macedonia, for, at his death, he was preparing to use it as his headquarters from which to rule the world.

All these empires and civilizations of Mesopotamia were made possible by the water and silt of the twin rivers, and they were constantly threatened with destruction by the same red mixture of water and mud. The back-breaking labor of shoveling silt from the irrigation canals was a job that the ruling classes and most of the other free people despised. It was done mainly by slave labor. When the native Mesopotamians were the conquerors, they depended on slaves captured from their conquests. When the Mesopotamians were the conquered, they were usually subjected to slavery and had to do the job. But in spite of the endless parade of conquerors, the razing of cities, and the annihilation of the peoples, civilization continued to thrive in Mesopotamia because the land remained fertile as long as the irrigation canals were kept open.

With the breaking up of Alexander's empire (323 B.C.), the Macedonian conquerors established the Seleucid Empire with Mesopotamia as its core. They built a new capital at Seleucia on the west bank of the Tigris a few miles north of aging Babylon. This was the beginning of the death of Babylon. She died not of conquest, but of neglect. The Seleucids evidently found it easier to build a new capital than to rejuvenate the old. The endless shoveling of mud from the irrigation canals around Babylon had piled huge mounds of silt along their banks. New canals had been dug and, in turn, abandoned. It became more and more difficult to get life-giving water to the land because of the many abandoned canals and their silt banks. Furthermore, the Euphrates had built up its channel so high with silt that it was constantly shifting its course.

So the ancient city that had been the most glorious capital of the world off and on for two thousand years finally passed into oblivion. The shifting desert sands soon covered the manmade scars and Babylon was forgotten for almost two thousand years, until modern archaeologists began to excavate its ruins.

The Seleucid Empire dominated Mesopotamia for nearly two centuries. Then the barbarian Parthians came as conquerors, around 140 B.C., and controlled the region for about 360 years. A great part of this time, the Romans were contesting them for control of the rich valleys. The Romans actually gained control of Mesopotamia for about three years (A.D. 114 to 117), but withdrew in favor of Parthian force.

Although the ten thousand square miles of desert that had bloomed under Hammurabi had shrunk pitifully, there were still large areas of irrigated land, and Mesopotamia was the richest province of the great empire of the Parthians.

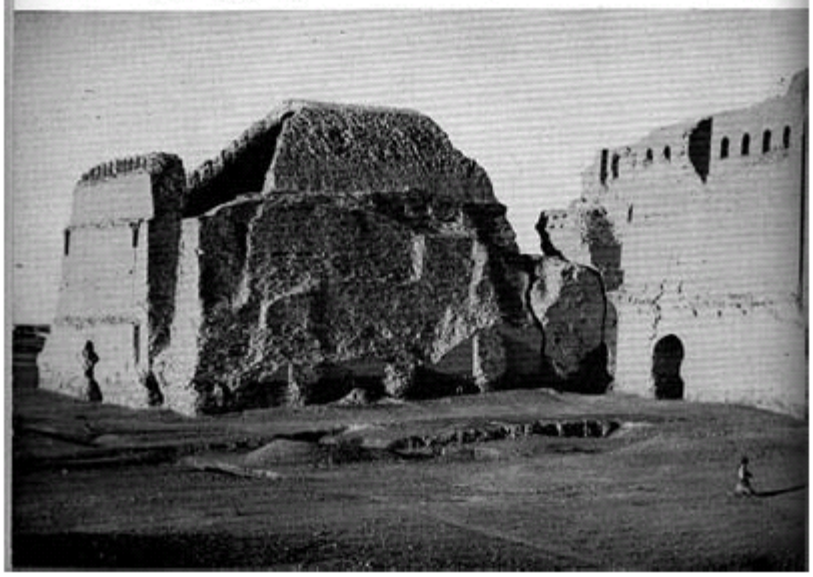
The headwaters of the Nile are now threatened by axes, plows and herds of grazing animals. These scenes are from Kenya, where the White Nile rises.

ABOVE: *A well covered landscape that represents the original condition of the country.*

BELOW: *Denuded slopes that have been cultivated, at times, and are now overgrazed continuously. Erosion and runoff have accelerated at a tremendous rate on much of the land of Central Africa in recent years.*

(Photographs by British Information Services)

The remains of two of the former great cities of Mesopotamia.
ABOVE: *Excavations at Kish, one of the oldest cities known to man.*
BELOW: *A palace at Ctesiphon, one of the later capitals (about A.D. 226 to 650) of the many empires that had Mesopotamia as their heart.*
(Photographs by Walter C. Lowdermilk, Soil Conservation Service)



A revolution in Parthia brought the Sassanian Persians to power in A.D. 226. With their capital at Ctesiphon, across the Tigris from Seleucia, the Sassanians created another empire that reached from the Indus River to the Mediterranean. This empire lasted for more than four hundred years, with fluctuating fortunes. During this time, Ctesiphon became a city of grandeur. At times it was one of the foremost cultural centers of the world. It was here that the last of the Greek philosophers came when Justinian closed the Academy and the other schools at Athens (A.D- 529). This empire, like those preceding it, fell into decay. It was easy prey for the Moslem Arabs when they came as conquerors in 637.

For more than a century, Mesopotamia was just another province of the Moslem Empire, but the lure of this potentially rich land was so great that around A.D 755 the caliphs established their capital there. They built the new city of Bagdad on the Tigris near the ruins of Ctesiphon, and thus began the last glorious chapter of Mesopotamia in the pages of world history. For about fifty years, Bagdad was the capital of a Moslem Empire that reached from Central Asia to the Atlantic Ocean. It was the political and cultural center of the most advanced civilization of that time.

With the death of the fabulous Harun al-Rashid (of *Arabian Nights* fame) in 809, the Moslem Empire began to break up; yet Mesopotamia remained one of the richest states of the Moslem world and Bagdad remained one of the richest and largest cities of the world.

The Seljuk Turks came out of the steppes of Asia to accept the faith of Mohammed and become masters of the region in the eleventh century. They established their main capital at Bagdad and soon brought most of the Near East under their control. For about a century they restored unity and prosperity to the region. As the Seljuks' power declined, dissension again split this Moslem Empire into numerous petty states. Then, in the thirteenth century, the Mongols of Genghis Khan came as conquerors.

The Mongols despised farmers and hated cities. In Mesopotamia they gave full vent to their feelings. They razed and burned most of the cities and massacred many of the inhabitants. They even deliberately set out to destroy the irrigation works that had functioned, in high or low degree, for more than five thousand years. They wrecked the great Nahrwan Canal and the large diversion dam that fed it. The floodwaters of the Tigris were no longer under even partial control, and they periodically surged over the area north of Bagdad and cut the land to pieces. This is one of the few areas of Mesopotamia that has been ruined by erosion--flood erosion, not rain erosion. The Mongol occupation was the beginning of the end for Mesopotamia as a seat of progressive civilization.

The Mongols ruled the region for about a century, during which time the agriculture of the area continued to decline. With the decline of agriculture came, of course, a decline of civilization. Then came the Black Death, which took a terrible toll of life in Mesopotamia, as in most other regions. More irrigation canals filled with silt. Then came the savage Tamerlane, who delighted in pyramids of skulls.

By the end of Tamerlane's reign (A.D. 1405), Mesopotamia was in a sorry plight. The mud and silt of the Tigris and Euphrates had almost completed the ruination of all the irrigation works that the Mongols had neglected to destroy. Farmers were probably producing less than a fifth as much food as had been produced during the high periods of Mesopotamian civilization. The population was much smaller, of course, after the plagues of Mongols, Tamerlane, and Black Death. But the area would doubtless have been repopulated in a few generations if there had been some easy way to restore the productivity of the land.

Declining productivity of the land and decreasing population are related evils. Regardless of which may be the cause and which the effect, the two usually go together, but they seldom stay in balance. A sudden decrease in the population of an area almost always causes a temporary decline in the food supply. This is mainly because there is a decrease in the number of farmers. But the natural reproductive tendencies of the human race usually bring about a repopulation of the area provided

the food supply can readily be increased.

Conversely, a rapid decline in the food supply of an area generally results in a decrease in population. Seldom does the population decrease as rapidly as the food supply, however, because the remaining inhabitants usually eat less. This, in turn, affects their physical stamina and often destroys much of their will to progress. The result too often is that the food supply, the number of people, and the vigor of the people all continue to decline.

Each situation is different. We will not attempt to set forth a formula to gauge accurately how these factors affect each other. In the case of Mesopotamia, however, we are advancing a theory based on the known facts and applied logic. We must use logic to some extent because all the facts are not known.

The Mongols, the Black Death, and Tamerlane greatly reduced the population of Mesopotamia. But, fully as important, they destroyed, or induced the destruction, of the irrigation works. The food supply decreased much more rapidly than did the population during the four or five generations that the Mongols and Tamerlane were devastating the land. By the time these savage conquerors departed, not only was the productive capacity of the land greatly decreased, but the will to progress of the people had been undermined. Most of the inhabitants had been on short rations for three or four generations. In addition, they had been subjected to a reign of terror for longer than the oldest inhabitant could remember. Those remaining apparently did not have the strength, courage, and vision to repair and reconstruct the irrigation works. Furthermore, the progressive accumulation of silt mounds along the banks of former canals and the choking of river beds with silt made the problem of restoration more formidable than ever before.

The Ottoman Turks took over the rule of Mesopotamia as Tamerlane's empire crumbled. They were much less savage in their treatment of the inhabitants, but they were still Turks. They treated these people of mixed ancestry much as they treated their cattle. The Turks were not irrigation farmers, they were seminomads from the steppes of Asia. Moreover, they established their capital in Asia Minor (later at Constantinople) and shipped much of the produce of Mesopotamia out of the region as tribute.

Another factor entered into the lack of reconstruction of the Mesopotamian irrigation works during the rule of the Ottoman Turks: there was no longer any slave labor. Throughout most of the history of this region, slaves were used to clear silt from the irrigation canals. Peasant farmers maintained some of the smaller ditches, but the large canals and ditches were maintained mostly by slaves of the state or of large landholders. The Mesopotamians had been a conquered people since the Mongol conquest, and they had few, if any, slaves. The Turks did not choose to make the reconstruction of the irrigation system a government project, as had many rulers before them. Hence, the irrigation works remained in disrepair, the people became poorer, and civilization stagnated.

Civilization remained decadent in Mesopotamia from the time of the Mongols to the twentieth century. It remained decadent largely because the fertile soil was unwatered. Walter C. Lowdermilk states that he crossed ninety-eight clogged and abandoned irrigation canals on one journey of 106 miles in 1939.* The banks of all these canals were piled with mounds of silt thirty to fifty feet high-silt that had been scooped out

through the centuries. just as noteworthy was his crossing of twenty-two closely spaced ranges of hard-packed earth-the remnants of eleven abandoned canals-with another partly choked but wet ditch alongside them. These may have been relics of eleven former empires, with the last ditch as evidence of today's feeble culture. (*Conquest of the Land Through 7,000 Years,* U.S.D.A., *Information Bulletin No. 99*, 5.)

The filling in of 130 miles of the Persian Gulf with soil since the time of the Sumerians is a significant fact. It means that over a period of five thousand years the rivers were building land at the head of the Gulf at an average rate of more than one hundred feet per year and that millions of tons of soil were coming down the rivers annually. Most of it came from the headwaters, because that is where the rain fell. All of this silt was not necessary. If the headwaters of these rivers had been controlled by forests, grass, or proper conservation measures on the cultivated fields, these river channels would have been stabilized and the silt loads greatly decreased. It was the misfortune of lower Mesopotamia that most of its life-giving water fell as intense winter rain on barren lands several hundred miles to the northwest. Most of the time, these headwater lands were outside the control of Mesopotamian rulers. At other times, they were under some degree of political domination. At no time, to our knowledge, was political control used to regulate land-use practices in the Armenian hills and mountains. The practices of deforestation and overgrazing contributed repeatedly to the downfall of Mesopotamia by destroying the mechanism of food supply. The procedure for dealing with silt after it reached the canals was not only laborious, cumbersome, and inefficient (since it had to be done every year), but subject to disruption by every war and revolution that occurred.

Today, the relatively small nation of Iraq rules most of Mesopotamia. It is an independent nation mainly because some of the more powerful nations of the world liberated it from the Turks in 1920. It still relics largely on the major powers to maintain its independence. This is quite a come-down for a region that led most of the civilized world for more than twenty centuries--about five times as long as the North American continent has been known to civilized white men.

Oil was discovered in this region during the twentieth century, and the government and a few of the inhabitants are now oil-rich. But most of the people still have a comparatively low standard of living. The country supports less than one-fourth as many people as it supported during the reign of Hammurabi nearly four thousand years ago. Why? Because the land does not produce enough to nourish the former population. People still live on things that grow from the soil.

Mesopotamia will be populous and perhaps prosperous once more only if the land is made productive again. Large parts of the country still have possibilities. Although it would require international agreements with Syria and Turkey, there is an excellent chance to rejuvenate this area by using the oil profits to construct the engineering works necessary for a new irrigation system and by controlling erosion in the upper watershed through reforestation and the regulation of grazing.

4. THE MEDITERRANEAN REGION

MOST OF the area surrounding the Mediterranean Sea, excepting Egypt, presents a striking example of man's rapid destruction of his environment. This region will be discussed in greater detail than most of the other regions, mainly for two reasons: we have more complete information about what happened there; and it is the region in which our Western civilization developed, and therefore is the region studied most intensively by students of ancient history in the United States.

The case histories presented from this region give rather conclusive evidence of how civilized man destroys his environment. This was one of the main regions the man doubtless had in mind when he said that "civilized man has left a desert in his footprints." However, this is not the only region where land destruction is obvious. In most other areas of the world land destruction and the decline of civilization followed much the same pattern, as will be pointed out later.

At one time, nearly every section of the Mediterranean region supported a progressive and virile civilization. Syria, Lebanon, Palestine, Tunisia, Algeria, Spain, Italy, Sicily, Yugoslavia, Greece, Crete, and Turkey have all, at times, been among the most prosperous and progressive areas of the world. Today none of these countries is prosperous, and few of them can rightfully be called progressive. Most of them are considered among the backward areas of the twentieth century world. Many of them have only one-half or one-third of the population they once had, and most of the people have a relatively low standard of living compared to that enjoyed by the people living in newer lands.

The pattern for the rise and fall of civilization is much the same for each of the different countries of this region. Their civilizations arose and progressed for several centuries on fertile land that had been built up by nature over the milleniums. As more and more of the land was placed in cultivation or denuded of its forest or grass cover, erosion stripped away the productive topsoil; continuous cropping and leaching removed much of the mineral plant foods; production declined. As the productivity of the land declined, the civilization it supported also declined.

Some countries prolonged their prosperity by conquering and using the resources of neighboring lands. But in the end, they, too, failed to maintain their progressive civilizations, because eventually they found themselves unable to conquer the additional resources they needed.

It is true that civilization never completely died in most of these Mediterranean countries. It is also true that a few areas, Italy for example, now have a greater population than in ancient times. Some persons may wish to argue that the people have a higher standard of material civilization than they had in ancient times. Certainly many have more machines and gadgets to help them do their work than they ever had before. But such mechanical devices do not necessarily constitute an advancement in civilization. If so, it might well be argued that some of the illiterate natives of Central Africa today are more civilized than were the ancient Greeks.

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In order to appreciate what has happened to the land and the people of the Mediterranean region, it is necessary to examine the land and the climate. Most of the land, aside from the Sahara and Arabian deserts, receives enough rainfall to produce

ordinary crops, provided the water is conserved and used for that purpose. But most of the rains fall during the winter, and often as torrential downpours. They do not come as gentle rains and mists dispersed throughout the year, as they do in most of Northwestern Europe. Furthermore, a large part of the land is of the rolling type, with gentle to steep slopes. Soil erosion may become severe in only a few years on cultivated land under such conditions. Once the forest and grass cover is destroyed on the hillsides, it takes constant vigilance to keep the topsoil from washing away. Vigilance alone may not be enough. Scientific knowledge of engineering, agronomy, forestry, and biology may be required to hold the soil in place.

While it is true that many of the Mediterranean peoples tried to practice some form of soil conservation as they saw their land slipping away from them, their conservation efforts were never adequate. They simply failed to recognize fully the hazards of farming hillside land where torrential rainfall was common. The ancients did not have the precedents of history to go by that we now have. And where they did recognize the danger, their science, apparently, was inadequate to formulate a lasting solution for their problems.

Some historians have assumed that there has been a change of climate in this region. A few produce some circumstantial evidence to show that the climate is gradually becoming more arid. This theory arises largely from the difficulty of understanding how countries that once had a prosperous agriculture and supported many fine cities can today support only a few herds of sheep or goats and their seminomadic herdsmen.

The facts, as we know them, however, show that there has not been any significant change in the climate during the last five thousand years. Cedars still grow in Lebanon, although there are few remaining. Grapes grow in Palestine, as they have for thousands of years, although vineyards are scarce. Olive trees grow in Tunisia, where the Carthaginians once planted large groves of them. These things could not be if the climate had changed noticeably.

The fall of past civilizations, especially those of the Mediterranean region, was due in large part to bad management of the landscape. Therefore, the "change of climate" theory should be examined with care.

The fact that the present climate is similar to that of two or four thousand years ago does not rule out the possibility of serious changes between these times. In fact, climatologists claim that there have been significant fluctuations in the climate of the Mediterranean region during the last seven thousand years. Richard J. Russell says reliable evidence indicates that there were relatively wet periods from around 5000 to 3000 B.C., during the thirteenth century B.C., from about 850 to 300 B.C., from A.D. 180 to 350, during most of the ninth century, and during the first half of the seventeenth century.* The periods between these times were considerably drier, and there were two severe long droughts: one around 2200 to 2000 B.C., the other around 1000 B.C. (*"Climatic Change Through the Ages," *Yearbook of Agriculture,* 1941, 67-97.)

These estimates are based on findings in Western Europe, Southwest Asia, and certain Mediterranean countries. The findings indicate that the long-range climatic changes were general for the entire Mediterranean region. Let's take these estimates, the most reliable we have, as being fairly accurate, and see if we can find any relation

between the climatic changes and the rise and fall of various civilizations.
The wet period from 5000 to 3000 B.C. predates any of the civilizations that were based on nonirrigated agriculture; hence, we are not concerned about it.
The dry period from 3000 to 1300 B.C. brought several significant developments. The Minoan civilization on Crete arose, grew to its zenith, and started its rapid decline; the Phoenician civilization in Lebanon was started and made substantial growth; and the Hittite civilization in Asia Minor appeared and advanced to its greatest height during this long dry period.
The wet period of the thirteenth century B.C. may have some significance, but we are unable to see what it is.
The dry period from 1200 to 850 B.C. witnessed a rapid rise in civilization over most of the Mediterranean region. Moses led the Hebrews into Palestine at the start of this period, and they rose to the height of their power as an independent people, under Solomon, toward the close of the period. The Phoenicians continued to advance and started colonizing the western Mediterranean. Civilization continued to advance over most of Syria. The Hittites succumbed, but most of their former empire was taken over by the Phrygians, Assyrians, and others. Etruscan civilization in western Italy emerged. Crete and Greece were going through a dark age, however, during most of the period.
The wet period from 850 to 300 B.C. brought some significant developments, but they follow no particular pattern. The Greeks developed their civilization to the height of its brilliance and then saw decline set in. Carthage and other sections of North Africa were settled and advanced rapidly throughout most of this wet period. Rome began to emerge as a world power and conquered most of Italy, while Etruscan power and civilization declined. Phoenicia gradually declined and all but passed into oblivion. The fortunes of Syria and Palestine fluctuated, mainly according to who was their conqueror.
If you consider Greece alone, you might well argue that Greek civilization was based on an agriculture that required above-normal rainfall, that the heavy rains speeded erosion and brought destruction to the land, and that the Greeks were then unable to compete in the following dry period. This argument makes little sense, however, when you consider the varied happenings in other Mediterranean countries.
During the dry period of 300 B.C. to A.D. 180, under Roman rule, most of the Mediterranean region enjoyed the greatest period of prosperity and advancement of ancient times.
Then the wet period from A.D. 180 to 350 saw a gradual decline in civilization and in the prosperity of most areas surrounding the Mediterranean.
The dry period from 350 to 800 saw the disintegration of the Western Roman Empire and the beginning of the Dark Ages for Western Europe. The Byzantine civilization of the eastern Mediterranean continued to exist, but apparently made little progress. The Arabs came forth as conquerors, however, during this dry period and established Islam as the foremost civilization of the time.
Civilization in Western Europe continued to decline toward the darkest part of the Dark Ages during the wet period of the ninth century. Apparently the Islamic and Byzantine civilizations were little affected, however.
The dry period from 900 to 1600 saw the decline of Islam, but the Renaissance of

Western Europe.

The wet spell of the seventeenth century brought severe floods to northern Italy and other areas; otherwise it seems to have affected the rise or fall of civilization only slightly.

It may be possible to analyze these happenings and arrive at sound conclusions about how climatic change has affected Mediterranean civilization. The authors are unable to do so, however. We only arrive at the conclusion that climatic change has not been an important factor in the rise and fall of civilization in the region.

It is reasonable to assume that the dry margins of semiarid lands contracted or expanded according to climatic variations. But to propose that civilization was chased from Babylon to London by a creeping drought is not reasonable. The evidence for climate as a destroyer of civilization is vague or nonexistent; the evidence of soil erosion is there for all to see.

A plant lives in two worlds, one above the ground surface, the other below. About half of the plant lives in each. Above ground is an environment whose factors are sunlight, temperature, moisture, wind, carbon dioxide, and oxygen, among others. The plant must be suited to these factors or it cannot flourish. If this atmospheric climate changes, plant species must change. We have noted that, around the Mediterranean, the plants of old still grow in some places.

Below the ground surface is an environment whose factors are darkness, moisture, temperature, air, humus, microorganisms, small animals, and minerals, and so on. If this soil climate changes greatly, the plant species growing in it must change. It is possible, even common, for soil climate to change while the atmospheric climate above it does not. One factor which can easily change is moisture. Moisture gets in the soil by the infiltration of water, and the infiltration rate may change radically. When rain falls on sloping land, it will do one of two things, and usually both: it will soak into the soil or run off. On land that is well covered with vegetation and has a loose, porous soil with an organic mulch, as much as 99 per cent of the rainfall may soak in.* Where a slope has been denuded of its porous topsoil by cultivation and continued erosion, the soakage may drop as low as 50 per cent. When this happens, there is a definite change in the soil climate: it becomes twice as arid. If the atmosphere supplies twenty inches of rain a year, only 50 per cent of which soaks into the soil, the plants living in the soil are no better off than if only ten inches of rain had fallen and all of it had soaked in. There are few of the cultivated crops of man that will thrive if they receive only ten inches of soil moisture each year. Even most of the better range plants will not grow well under such conditions. (*The rates of infiltration have been measured thousands of times on soil conservation experiment stations in the United States since 1929.)

We do not contend that all the lands of the Mediterranean region have deteriorated to the point that only 50 per cent of the rainfall soaks into the soil. We do contend, however, that the amount of rain infiltration into the soil has been greatly reduced on most of the land of the region. This is the main reason why much of the area looks so desert-like today. it is the main reason why many observers came up with the now discredited climatic-change theory.

5. CRETE AND LEBANON

IT WAS in the eastern Mediterranean region that civilized man staged his first bouts with an agriculture that relied on rainfall. That is where he should have learned about the erosive power of torrential rains falling on bare, sloping land. Apparently he did learn something about the power of rain, but not enough about how to control it.

As civilization spread from the valleys of the Nile and Mesopotamia to the shores and islands of the Mediterranean, civilized man came into a different environment. He had learned, over a period of two thousand years or more, how to practice a permanent agriculture on irrigated land. He had known for at least three thousand years how to plant and harvest crops on nonirrigated land. But never before had he attempted to practice a permanent agriculture on sloping land with rainfall as his water supply. Primitive farmers had never tried to farm such land for more than a few years at a time, but had practiced a shifting agriculture, just as do many primitive farmers today.

The civilized farmers from the irrigated valleys, however, tried to transplant the type of agriculture they had learned on the stable lands of the Nile and Mesopotamian valleys. They did not need to farm the same land for a thousand years or longer in order to become civilized: they were already civilized. They were civilized enough to think that they could impose their will on nature, and the results of their trying to do so ranged from poor to disastrous.

Remains of the Cedars of Lebanon. This is one of four small protected groves of cedar now in Lebanon, where there was once a magnificent forest of more than one million acres. Note the eroded hills and mountains that produce little except silt to clog the drainageways and create malaria-infested marshes in the valleys and on the coastal plains.

(Photograph by Walter C. Lowdermilk, Soil Conservation Service)

"Civilized man has marched across the face of the earth and left a desert in his footprints."

ABOVE: *This view shows the twentieth-century ruins of Palmyra, Syria, once known as the "Queen City of the East" and a rival of Rome as a capital city for the eastern half of the Roman Empire. The small village, in the right background, properly represents the productivity of the land today.*

BELOW: *The Promised Land—3,200 years later. This view shows the sorry state to which the "Land of Milk and Honey" has deteriorated under civilized man's occupation.*

(Photographs by Walter C. Lowdermilk, Soil Conservation Service)

The civilized farmers on the island of Crete were probably the first men to build a civilization based on rain agriculture. Neolithic man first occupied Crete around 5000 B.C. according to archaeologists. The Minoans of Crete are presumed to have become civilized shortly after 3000 B.C. Their civilization apparently grew and prospered for about fifteen hundred years, then declined and disappeared in approximately two centuries.

The Minoans inherited much of their civilization from the Egyptians and the Mesopotamians. But by 2000 B.C., they had a distinctive civilization of their own. At its zenith, the Minoan civilization was one of the most artistic of antiquity. The Minoans were also great engineers and architects. Their palace at Cnossus, with its

labyrinth, was one of the marvels of ancient times. Their paved highways and streets, aqueducts, sewer systems, and drainage projects were superior to anything found in the Mediterranean region before Roman times. But, above all, the Minoans were sailors and navigators.

At the height of their power, around 1600 to 1400 B.C., the Minoan navy dominated the Aegean Sea and most of the eastern Mediterranean. So dominant was their sea power that they never felt it necessary to fortify their towns or cities. They definitely sailed as far west as Sicily, and probably as far as Spain and France. They carried on regular commerce with Egypt, Phoenicia, Syria, Asia Minor, and Greece. They conquered and colonized most of the islands of the Aegean Sea and many sections of the Grecian peninsula.

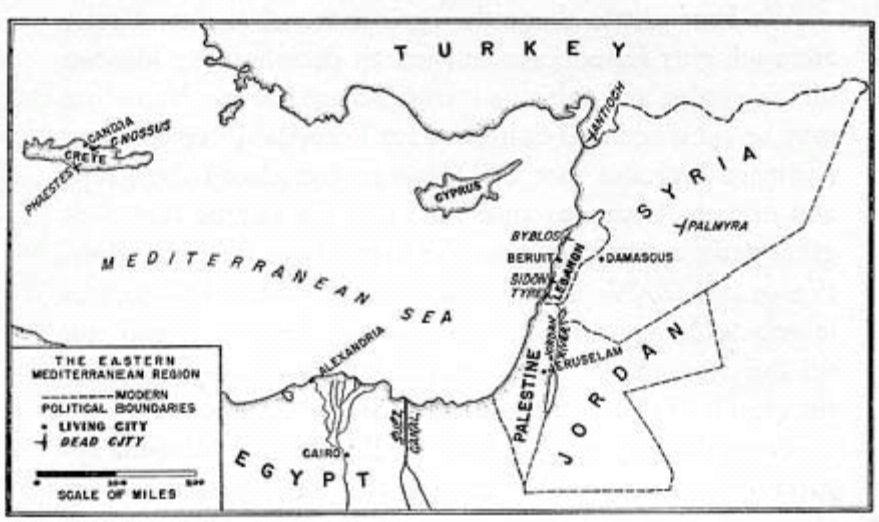
We know little about the agriculture of ancient Crete: archaeologists have never learned to decipher the Minoan hieroglyphics, and cultivated fields do not leave artifacts that may be exhumed and examined for historical interpretation. Evidence indicates that the Minoans introduced the grape and olive to Greece around 1500 B.C. We assume that they grew grain extensively from the beginning of their civilization to its end. We also assume that the island of Crete was largely self-supporting before 1600 B.C., because it was not till then that the Minoans started extensive colonization of the islands of the Aegean Sea and parts of Greece.

From the beginning of their civilization, the Minoans apparently had an uninterrupted period of development for about one thousand years. Then, in the nineteenth century B.C., a catastrophe of some type destroyed most of their cities. Conquest does not seem probable, because the rebuilt cities were still unfortified. Possibly the destruction was caused by civil wars.

A period of stagnation ensued for two or three centuries. Around 1600 B.C. the cities were rebuilt on a grander scale than ever. The entire island was apparently included in one empire with Cnossus as the capital.

Although the Minoans may have imported grain before 1600 B.C., population pressure on the land was not intense enough to force extensive migration and colonization of other lands. But the extensive colonization in the sixteenth and fifteenth centuries indicates that Crete was becoming overcrowded.

Arthur Evans estimates that the population of Cnossus alone was about 100,000 during the fifteenth century.* Phaestes, on the south coast, also was a large city, and there were many other cities and towns on the island. It is estimated that the total population of Crete at this time was about one and one-fourth million. This was more people than the three thousand square miles of mountainous island could feed adequately, especially if much of the land had already declined seriously in productivity. (* *The Palace of Minos,* I, 26.)



For two centuries after 1600 B.C., the Minoans enjoyed a golden age of prosperity, but their downfall was sudden. Practically all the cities were destroyed by fire about the same time, around 1400 B.C. Their conquest by barbarians seems probable. After that catastrophe, Minoan civilization never recovered. It did not die overnight, but lingered on for about two centuries. After the conquest of 1400 B.C., however, the Minoans were never again an important factor in eastern Mediterranean civilization. Crete did not recover as did Egypt after the Hyksos conquest, or Mesopotamia after a number of conquests. For the next two hundred years, the main centers for Minoan civilization were Mycenae and Tiryns on the Greek Peloponnesus. After that, the Minoans were seldom heard of, and a few centuries later they were all but forgotten, even by the Greeks who inherited their civilization. By the fifth century B.C., the Greeks used the word "Cretan" as a synonym for a stupid, dull-witted person.

Why did the brilliant civilization of the Minoans come to such an abrupt end? It had survived a catastrophe that laid all its cities low some five hundred years earlier and came back to greater heights than ever. Assuming that the Minoans were conquered by the barbarian Greeks, why should that conquest so completely destroy their 1,500-year-old civilization?

The only feasible answer seems to be that the Minoans despoiled their homeland to such an extent that it would no longer support a prosperous and progressive civilization. During the last two centuries, 1600 to 1400 B.C., they depended to a large extent on imported food, sea power, colonies, and commerce to support their luxurious civilization on Crete. When their domination of the sea was destroyed, they did not have the resources to stage a comeback and consequently became dependent on such favors as the colonies were willing to grant. The result was a gradual but fairly rapid decline. Within a few generations, they were wholly dependent on the resources of the island of Crete, and these resources were capable of supporting only a meager civilization.

Today, nearly two-thirds of the island is a stony waste; erosion has stripped most of the soil from practically all the sloping land. Crete is a poverty-stricken country that has about one-third of the population it had in 1400 B.C. All the erosion and land deterioration did not come after the Minoan civilization declined. The evidence

indicates that most of it came before the decline. If Crete had still had the resources that lifted her to a high state of civilization, she would have recovered, regardless of the thoroughness of the conquest. To repeat, war has seldom, if ever, obliterated a civilization. It has sometimes nearly obliterated the civilized people, but the conquerors or others have always rebuilt the civilization in every place where a favorable environment remained.

The story of Lebanon is similar to that of Crete. The time, place, and details vary, but the history of land use and the attempts to solve the problems of overpopulation and diminishing resources seem essentially the same for the Phoenicians and the Minoans. We know more about what happened to the Phoenicians, however, and can present a clearer picture of their trial-and-error methods of trying to solve these ageold problems.

The Phoenicians, who borrowed most of their culture from Mesopotamia, Egypt, and Crete, probably settled the country now known as Lebanon between 2500 and 2000 B.C. Apparently never great creators, they were great imitators and distributors of civilization. The Phoenicians were primarily responsible for disseminating the alphabet over most of the Mediterranean region. They possibly learned navigation from the Minoans, whom they soon surpassed in this skill, and became the foremost merchants, traders, and seafaring people of the known world from about 1000 to 500 B.C. They were the first people of the Mediterranean to venture out into the Atlantic Ocean, sailing as far as Britain seven hundred years before Caesar, and circumnavigating the continent of Africa two thousand years before DaGama of Portugal gained fame for accomplishing that feat.

The homeland of the Phoenicians consisted of a relatively narrow strip of coastal plain, back of which was another strip of foothills that rose steeply into the Lebanon Mountains. The coastal plain and foothills undoubtedly had fertile soil when these people settled there, and enough rain falls there to produce excellent yields of grain, grapes, olives, and most other crops grown by the ancients. Before crops were grown by man, nature grew lush crops of grass and forests, including the famed "Cedars of Lebanon." The chief trouble was that the amount of easily tilled land was definitely limited by the mountain range.

The Lebanon Mountains gave the Phoenicians considerable protection from warlike inland tribes. They were not overrun by conquering armies as often as were most of the other peoples of the eastern Mediterranean region. But the mountains also served to hem in the Phoenicians as well as keep out their enemies. It seems logical to assume that their population grew faster than that of most other peoples surrounding them because of the protection against war that the mountains afforded. Hence, we may assume that the Phoenicians literally pushed themselves out into the Mediterranean Sea, and probably became sailors and merchants more from necessity than from choice.

Early in their history, the Phoenicians found that they had an easily marketed product, timber, growing in their homeland. The people of the treeless plains of Egypt and Mesopotamia were hungry for timber; building with stone and clay alone has its limitations. So the Phoenicians, using bronze axes, started lumbering off the forests. They used what wood they needed for their buildings and ships and exported the surplus.

But the Phoenicians found it necessary to eat. The narrow coastal plain between the sea and the hills soon became inadequate for the expanding population. With only one way to go, cultivated fields began to creep up the cleared slopes. Hill farms took over the formerly forested land as rapidly as the trees were cut. Erosion began almost at once when the winter rains came. Most of the slopes were steep, ranging up to 75 per cent (about 34 degrees). Generally speaking, soil conservationists in the United States consider slopes of more than 20 to 25 per cent unfit for cultivation; such sloping land should be kept covered with forests or grass.

Food was always a problem. Lumber was traded to Egypt and Mesopotamia for grain, but it was seldom enough. The Phoenicians, having an abundance of timber and a driving need, expanded their lumbering activities. They built more ships and expanded their export trade, while villages of lumberjacks sprang up in the mountains. Palestine, to the south, became another good market for timber. King Solomon was a very good customer in the tenth century. Some 150,000 men labored in the Lebanon forests to supply timber for his palaces and temples and for homes for other wealthy Hebrews.

We do not know whether the forests were cut primarily to get the timber and hill farms were the by-product, or whether the clearing was done mainly to get more farm land and timber was the by-product; but the two went together--deforestation and hill farming. Both continued at an increasing rate, while soil erosion accelerated rapidly.

The Phoenicians were not easily defeated in their fight against nature. They had plenty of stone on the cleared hillsides, and they made unique and profitable use of it. They constructed rock walls across the slopes and made the first bench terraces known to history. They built some of these rock-wall terraces probably as early as the fifteenth century B.C. In time, they terraced thousands of acres in this way.

The construction of such terraces requires a tremendous amount of labor and is undertaken only by people faced with starvation. The cost of labor alone to terrace a single acre would amount to at least $5,000 if figured at current American wages. Some of these terraces are still cultivated today, more than three thousand years after they were built, and the ruins of many others are still visible. Faulty engineering, the power of cloudbursts, and the lack of repairs led to the failure of many of the formerly terraced slopes, which are now eroded to bare rock.

Where terracing was established as a community habit, the farmers, at least, had food, but they probably produced little surplus since the cost, in labor, of constructing and maintaining such terraces limited cultivation to rather small areas and thus prevented the production of any large yields. Yet the food production might have been adequate to maintain a moderately prosperous civilization if all the land had been terraced, but only a small part of the deforested hillsides was so treated.

The Phoenicians were probably a nomadic tribe originally, and most individuals were not inclined to the hard labor of terrace agriculture. Goat herds were favored by many as a source of livelihood. As the two thousand square miles of forest were slowly cut and herbaceous plants appeared, the goats took over. Stories told about the indestructible digestive systems of goats are not without foundation--a goat can eat almost any type of vegetation, including young trees; he can go almost anywhere to get food, even to the most inaccessible crag; and he can even climb certain types of trees and eat the leaves or fruits.

It seems certain that the desolation which is Lebanon today can in part be traced to the goats. Where the forests might have recovered to protect the soil, prevent floods, and provide a continuing economic asset, the goats prevented such recovery. Seedling trees, starting from windblown seed, were eaten and killed as fast as they appeared. Deforestation and the scavenger goats brought on most of the erosion which turned Lebanon into a well-rained-on desert.

By the ninth century B.C., the Phoenicians found that their lumbering, industry, commerce, and meager agriculture were inadequate to support their growing population. Colonization of other lands became almost imperative. They began by founding colonies along the coast of North Africa and eventually colonized all the poorly defended lands along the coast of the western Mediterranean. Carthage and other points along the North African coast, Sardinia, Sicily, Spain, and other colonies, soon became the breadbasket for Lebanon. The Phoenicians in Lebanon shipped manufactured products to the colonies in exchange for food, and not only did this trade supply food for the cities in Lebanon, but it also stimulated commerce and industry. According to custom, the colonists usually paid the high shipping charges both ways, while the Lebanese merchants exacted fat profits on all transactions. Furthermore, the enterprising merchants of Lebanon opened trade relations with the people of practically all ports of the Mediterranean, and some of them even traded with the barbarians of Atlantic ports, especially with the Britons. They also traded overland with Mesopotamia and far eastern countries. By the end of the eighth century B.C., they had almost a monopoly on shipping in the Mediterranean.

From the eighth through the sixth centuries B.C., the Phoenicians had their golden age. Lumbering continued, and both industry and trade prospered, but the prosperity was mainly confined to the port cities. The land of Lebanon was by now so poor that it afforded little more than subsistence living for the farmers and goatherders who occupied it. When an occasional conquering army came through the passes of the Lebanon Mountains, it paid little attention to the farmers. Tribute levied on Tyre, Sidon, Byblos, and the other rich cities was paid mainly by taxes assessed against the wealthy merchants and shipowners. Fortunately, such conquerors did not come too often during this prosperous period.

The Phoenician prosperity had definite limitations because it depended on ever expanding industry and trade, which, in turn, depended on sea power. In this last area the Greeks began to challenge them during the sixth century B.C. By the time of the Greek and Persian wars, the Greeks had become such formidable competitors that the Phoenicians gladly sent a large fleet to fight with the Persians. Then the Greeks defeated the combined fleets of the Phoenicians and other Persian satrapies at Salamis in 480 B.C. This was the beginning of the end of progressive Phoenician civilization. Commerce declined rapidly, and the decline of industry followed. Lebanon became more and more dependent on her colonies, especially Carthage, which still dominated the western Mediterranean.

After Alexander conquered all Lebanon, destroyed the principal city of Tyre, and killed or sold into slavery that city's inhabitants in 332 B.C., Phoenicia was never again an important factor in eastern Mediterranean civilization. And after Rome destroyed Carthage in 146 B.C., the Phoenicians, like the Minoans, were soon forgotten.

By the time of Alexander's conquest, there were few resources left in Lebanon. Most of the forests were gone, and the remaining trees disappeared within a few centuries under Greek and Roman axes. Most of the topsoil was gone from the hills, lowlands were covered with erosional debris, harbors were silting up with mud from the eroding highlands, and river deltas were marshy pestholes infested with malariabearing
mosquitoes. Civilization in Lebanon could not rise again, as it had in Mesopotamia and Egypt, because the resources were no longer there to support it. The total life span of progressive civilization in Lebanon was little more than fifteen hundred years (about fifty or sixty generations).

It seems logical that during the 2,300 years that have since passed nature would have repaired most of the damage done to the land--and nature doubtless would have done so if given a chance--but Lebanon has been kept down mainly by man and his goats. Much of the former forest land, now reduced to four small groves, is so severely eroded that only geologic weathering can build a new soil, a process that will require thousands of years and no goats.

Some of the Phoenicians made a valiant effort toward saving their land. A small minority, whose insight or need led them to the root of the evil, built bench terraces, regardless of cost and hardship, and attempted to insure for themselves and their descendants a permanent basis for survival. The majority, however, in their ignorance, greed, laziness, or preoccupation with shekels and commerce, ignored what was happening to the land. Apparently they never considered sustained-yield forestry, which might have given them a continuing export trade in lumber. If they did think of it, their goats prevented them from practicing it. In other words, their conservation efforts were both too little and too late.

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As we follow the western trek of civilization across the Mediterranean, Europe, and the Atlantic, what variations do we find? Where, if any place, has society as a whole become aware of the facts of conservation?

The lands and peoples of the earth are all different. The forces which stimulate civilizations and the conditions which lead to decline are different. But the earth and man operate under natural laws, and these laws remain the same for all situations. No matter how complex any given situation may be, it should yield to analysis. We recognize that history cannot be reduced to an exact science of logic and law. Yet we hold that the causes and effects for most of the broad trends can be determined by the application of logic to the known facts.

One reason for the difficulty in drawing clear-cut lessons from history has been the almost exclusive reliance on documents and artifacts. Historians, in general, have been lax in their autopsies on dead civilizations. A dying man may reveal symptoms to his doctor, but the doctor cannot be positive of the cause of death on such evidence. The condition of the body, internal as well as external, at the time of death, must be examined critically. It is true that death itself produces certain changes, and the examiner must recognize these and differentiate between them and true pathological conditions. The historian likewise has this problem. If he assumes that the environs of a former civilization got into a state of decay after the culture succumbed, he may be making a mistake which will invalidate all subsequent conclusions. If, on the other

hand, the landscape was deteriorating at the same time the culture was declining, a nice problem of cause and effect is posed.

At this point, not only the records but also logic and scientific principles must be invoked, because complete records are seldom available. It is definitely a fact that fertile and reasonably extensive areas of soil must be available before civilization can begin. Then the efficiency of soil use becomes a factor. The management of water, whether irrigation or rainfall, the selection of seed, the invention of implements, and other factors help determine the amount of surplus yield and the release of workers to the cities. All the progressive civilizations managed their land and water in such a way as to increase production as long as the basic resources remained static.

But what happens when the land deteriorates? If excessive runoff is brought on by denudation of sloping land, if topsoil is lost by erosion, and if crops like trees and grass are prevented from reproducing because of overgrazing, then nothing can follow but reduced yields, loss of surplus, withering of cities, and decline of culture.

Phoenicia would be an interesting case if placed against a modern background. Its history closely parallels that of some modern nations. The government and the city people ignored what happened to the land and its vegetation. Hunger came. The problem seemed solved by trading an indigestible natural resource (wood) for food from other countries. As the natural resources for export declined, manufacturing skills and commerce were intensified. But food was still a pressing matter: shipping loads, transportation charges, and handling fees levied on other countries' goods were increased. Hunger came again as the population grew. Migration and colonization of fertile distant lands followed. Through trade, taxes, and monopoly of transportation, food was again routed to the homeland, but the homeland was extremely vulnerable. The sea-route lifeline had to be guarded; a strong navy became necessary. When the dominance in sea power was lost, the lifeline was lost. Decline was inevitable.

When a civilization is stripped down to its fundamentals and the intricate vestments are removed, the view is different. Each culture should be examined from the point of view of mankind in general. Wars may come and go; floods, plagues, and depressions wax and wane; tyrants and demagogues rise and fall; but these are not the fundamentals. The main question is this: Can the woodcutter, farmer, miner, mason, sculptor, artist, writer, businessman, and other essential workers come through the unpleasantness and go on with their work? It matters little, to the culture, if an individual gets killed, provided someone takes his place and does his work. Nor does it matter much whether the substitute be native or alien. The work, the production, is the main thing.

But production depends to a large extent on natural resources. Every worker is supported by the land. This was true in Phoenicia three thousand years ago, and this is true in the United States today.

6. SYRIA AND PALESTINE

NORTH AND EAST of Lebanon is Syria, with a somewhat different environment. Although the coastal plains of Syria receive about thirty-five inches of rainfall annually, the amount decreases as you go inland. Over a great part of central and eastern Syria, the rainfall is insufficient for agriculture. In ancient times, irrigation was used where water was available. Where there was no water supply for irrigation, goat and sheep grazing was generally practiced.

The semiarid climate of most of Syria helped, to some extent, to preserve the land from destruction by civilized farmers. The lesser rainfall caused a slower rate of erosion and prevented the intensive cropping that was practiced on the coastal plains of Lebanon. Also, the broader valleys and broader stretches of comparatively level highlands between the hills and mountains of Syria did not, of course, erode nearly as rapidly as did the steep slopes of Lebanon.

Another factor tended to preserve the land of Syria--war. The exposed position of the Syrian plains, lying between such ancient powers as the Egyptian, Hittite, and Mesopotamian empires, made it an almost constant battleground. As conquering armies surged back and forth across the land, many of the farmers were routed from their homes and farms, and their herds of livestock were slaughtered or driven off. Often the land was left uncultivated and ungrazed for generations at a time. During such periods of rest, nature had a chance to restore a part of the lost productivity by growing unharvested crops of weeds, grass, and brush.

Thus, civilized man found one of his more durable homes in Syria, where civilization waxed and waned on a fairly progressive basis for about three thousand years. This is not nearly as long as the six thousand years that the Nile Valley remained a suitable home for civilized man or the five thousand years of productivity of Mesopotamia, but it is much longer than most of the other lands of the earth have lasted under civilized man's stewardship.

The details of the hectic history of Syria will not be discussed, for Syria, as a nation, has little history. Up to the twentieth century, this unfortunate land was almost continuously under the rule of some foreign power. When it was not under foreign rule, it was usually a battleground for competing powers that wished to possess it, or it was a series of battlefields for petty local chieftains and city-states.

The natives of Syria probably got their first glimpse of civilization when Sargon I of Akkad marched his army across the land in the twenty-fourth century B.C. This region was not really civilized, however, until several centuries later. It was not until around the eighteenth century that the repeated visitations of the Mesopotamians and Egyptians brought true civilization to most of Syria. Since then, the land has been a parade ground for conquerors.

The Babylonians, Hittites, Egyptians, Mittani, Assyrians, Chaldeans, Persians, Armenians, Macedonians, Romans, Byzantines, Sassanians, Arabs, Turks, Kurds, Mongols, European Crusaders, French, and many others have marched their armies across Syria and at some time ruled a part or all of the area. From the beginning of historical records until the thirteenth century A.D., the land of Syria was apparently considered rich spoils of war by the various monarchs and potentates who invaded it and exacted tribute from those who dwelt there. Since the thirteenth century, the land

has hardly been worth conquering.

The people living in Syria were seldom warlike. They were of such mixed ancestry that they had little national pride, and they were so often confronted with powerful armies that military resistance did not seem worthwhile. The location that made Syria a battleground also served to make it a trade route between various empires. In order to subsist and raise the heavy taxes and tribute assessed on them, the natives resorted mainly to trade, supplemented by such agriculture as they were allowed to practice.

Syria probably reached the height of its prosperity under Roman rule, during the first three centuries A.D. This was not because the Romans were lenient rulers, but because that period was one of the few in Syrian history when the country was not racked by war. At that time, Syria had a population of around nine million. Today less than three million people eke out a precarious existence there. During Roman times, there were hundreds of prosperous towns and a dozen or more large cities that thrived from the agriculture, industry, and commerce of the area. No province of the Roman empire surpassed Syria in industry and prosperity.

Damascus has been the capital of Syria, off and on, for three thousand years or more. It was a prosperous trade center during Roman times and is still relatively prosperous. It is one of the few ancient cities that still exists as an important trade center. Most of the others have withered or died, mainly because the land around them has died.

One of the richest and greatest cities of ancient Syria was Antioch. It served as one of the capitals of the Seleucid Empire for more than two centuries and was one of the great cities of the eastern Mediterranean during Roman times. In the second century A.D., the city of Antioch had a population of around 500,000. The main avenue, four and one-half miles long, was paved with granite and had a covered colonnade on each side so that people could walk along it without being exposed to the sun or rain; it had street lights that would rival the lighting systems of some modern American cities; running water was supplied to most houses; and there were many amusement places, including a circus, a large amphitheater, and numerous public baths and brothels. Its port, Seleucia, about fourteen miles downstream, was one of the busiest shipping centers of the Roman Empire. It was in Antioch that St. Paul first began preaching the Gospel; he doubtless chose Antioch as the place to start the spread of Christianity because it was the largest and most cosmopolitan city with which he was acquainted.

Another once famous city and a great trading center for centuries was Palmyra. During the reign of Odenathus and Zenobia in the third century, Palmyra ruled a great empire and waged war against Rome, Parthia, and Persia. For a while, the Roman Senate recognized Palmyra as the capital of most of the Asiatic provinces of the Roman Empire.

Some historians have concluded that the land of Syria was despoiled and ruined by the Arab, Turk, and Mongol occupations between the seventh and fourteenth centuries. They realize that by the time the Ottoman Turks took control of the land in the fifteenth century, it was no longer productive. But this is not a true picture of what happened to the land of Syria. Its deterioration doubtless began in the twenty-fourth century B.C. when the first civilized men visited it. The erosion and soil-depletion process was slow at first, for frequent wars fought in and around Syria tended to preserve the land rather than destroy it, as has been pointed out.

The land itself probably suffered most during the period of Roman occupation, when Syria was most prosperous--when most of the arable land was cultivated continuously, high rents were exacted, and most of the surplus produce was exported. The situation was little better when the Byzantine Empire took over after the fall of Rome. By the time the Arabs came, the soil was already depleted, and many fields were ready for abandonment. The Arab and Mongol occupations, with their dry-land farming and grazing herds, simply prevented the abused land from recovering and witnessed the final death throes of the land of Syria.

Now for a look at Syria as it is today. The once famous city of Antioch, located on the north bank of the Orontes River in what is modern Turkey, was partially destroyed by an earthquake and was sacked by invading armies several times between the fourth and twelfth centuries A.D., but its final destruction came around 1268, during the wars of the Crusaders and Moslems. When modern archaeologists started excavating its ruins, they had to dig through as much as twenty-eight feet of water-borne silt to uncover some of the former palaces. This was silt that had washed off the cultivated and deforested highlands in the watershed above.

The Plain of Antioch, in the valleys of the Orontes and its tributaries just north and east of the city, shows similar signs of huge silt deposition. This plain contains about two hundred square miles of relatively level land, most of which was formerly cultivated and which produced excellent yields of grain, olives, and other crops without irrigation. The ruins of about 175 different towns and villages on this plain testify that it was thickly settled in ancient and medieval times. Some of the ruins date back to 2000 B.C. or earlier. Present archaeological research indicates that there were at least ninety to one hundred different towns and villages on this plain during Roman times.* (*Robert 1. Briadwood, "Mounds in the Plain of Antioch," *University of Chicago Oriental Institute Publications,* Vol. XLVIII, 12-47.)

Only seven inhabited towns are found on this plain today, and only a small part of the land is farmed. Nearly one-fourth of the plain is covered by a marshy swamp created by silt that blocked the flow of the streams, and the ruins of about twenty-five of the former towns are partially submerged in this swamp. The remainder of the plain is covered by leached-out erosion debris from the highlands. The silt deposition over parts of the plain has been so great that the floors of some of the earliest towns are now below the ground water table. Furthermore, the ruins of most of these former towns are covered by mounds of dust and sand--mainly the products of wind erosion from formerly cultivated fields.

Where did all the silt come from that buried the Plain of Antioch and the ruins of the city itself? Lowdermilk gives a good indication of the origin of the silt in his description of the "Hundred Dead Cities" of Syria:

"Syria holds some of the greatest ruins to be found in the ancient world, such as Baalbek and Jerash. But to a soil conservationist the most striking ruins are found in the graveyard of a 'hundred dead cities.' An area of about a million acres in North Syria, lying between Aleppo, Antioch, and Hama, exhibits soil erosion at its worst. Here are ruins of villages and market towns resting on the skeleton rock of limestone hills, from which 3 to 6 feet of soil have been swept off. Evidence of the depth of soil eroded from these slopes is found in

doorsills of stone houses now 3 to 6 feet above the bare rock.

"Here soil erosion has done its worst and spread a ghastly destruction over a formerly prosperous landscape . . . which we examined in the summer of 1939. In reality, these cities are dead, with no hope of resurrection; for the basis of their prosperity is gone. These cities have not been buried, but have been left high and stark by the removal of soil through ... erosion. The good earth . . . is completely gone from the slopes except in patches where it is held back by walls of ruined buildings or in pockets in the limestone. In these patches a few vines and olive trees stand as sad remnants of a former profitable use of the land, which provided exports of olive oil and wine to Rome during the empire. Seminomads now inhabit repaired ruins in a few of the former cities."* (**Conquest of the Land Through 7,000 Years,* U.S.D.A., *Information Bulletin No. 99,* 10.)

Now for a look at Palmyra. It is not covered with waterborne silt. Some of the ruins stand high and dry on the man-made desert, and others lie beneath the shifting desert sands. Only a small, poverty-ridden village now occupies the site of this once rich city. Palmyra died mainly because the land of Syria and surrounding areas died. There is no large group of rich merchants and traders to support an opulent city today. The country is not capable of producing the wealth to make extensive commerce possible. The story is much the same in Palestine as it is in Syria.

We shall not attempt to even outline the history of Palestine. Volumes have been written about it, and it is too confusing to be even partly discussed in a book of this length. Here, too, the land has been a battlefield or military highway for foreign armies since the beginning of historical records. When foreign armies were not occupying the country, civil wars usually prevailed. The main difference between Syria and Palestine is that for more than one thousand years the Hebrews occupied most of Palestine and tried to develop a sense of national pride and independence. They even succeeded for relatively brief periods, but the foreign invasions and exploitation of the land were always resumed. It was not the conquering armies that depopulated the land, however. It was the inexorable laws of nature.

The climate of Palestine is typically Mediterranean. Enough rain falls in most areas to nourish the crops grown by the ancients. As long as the soil was capable of absorbing the rainfall, this was a relatively prosperous and beautiful country. In the first century A.D., Josephus described the land of Galilee, Samaria, and Judea: ". . . the soil is universally rich . . . these countries are moist enough for agriculture, arid very beautiful. They have an abundance of trees, both wild and cultivated, that are full of fruit. The land is not naturally watered by irrigation, but chiefly by rainfall, of which they have no want."* (*Flavius Josephus, *Wars of the Jews.)*

The area probably looked even better to Moses and the Israelites when they migrated there around 1200 B.C.

W. C. Lowdermilk, in a very interesting study of land use in Palestine, has this to say:

> "When Moses stood on Mount Nebo and looked across the Jordan to the 'Promised Land' about 3,000 years ago, he described the land to his followers as a 'land of brooks of water, of fountains and depths that

spring out of valleys and hills; a land of wheat, and barley, and vines, and fig-trees, and pomegranates; a land of olive-oil, and honey; a land wherein thou shalt eat bread without scarceness; thou shalt not lack anything in it; a land whose stones are iron, and out of whose hills thou mayest dig brass.' The 'Promised Land,' as it is today, is a sad commentary on man's stewardship of the earth.

"The 'Promised Land' which 3,000 years ago was 'flowing with milk and honey' has been so devastated by soil erosion that the soils have been swept-off fully half the area of the hill lands. The soils have been washed off the hills into the valleys where they are sorted: the finer particles are swept out in flood waters to change the beautiful blue of the Mediterranean to a dirty brown as far as the horizon; the coarser particles are spread out on former alluvium where they are still cultivated but in a progressively reduced area. Accelerated run-off from barren slopes continues to cut gullies through the alluvial valleys and to carry erosional debris out to choke up the channels of streams flowing through the coastal plains.

"In times past, such erosional debris together with sand dunes blown in from the coast created marshes in the plains; then malaria came in, practically depopulating the lowlands. The hills also have been greatly depopulated. . . . erosion in the hills, as well as marshes with malaria in the coastal plain, have been sufficient to reduce the population of the 'Promised Land' to one-third of the Roman period.

"Palestine can never be restored to its original condition as the 'Promised Land'; it can be much improved over its present condition as the splendid works of the Jewish colonies on 5 per cent of the total area have demonstrated, but the lands have been so devastated by the irreversible process of soil erosion in the uplands that they can never be restored to their original productivity. . . . it is too late."* (*"Lessons from the Old World to the Americas in Land Use," *Smithsonian Report for 1943,* 417-18.)

7. GREECE

THE ANCIENT Greeks followed much the same path traveled by their predecessors, the Minoans, and their early rivals, the Phoenicians. The principal differences were that the Greeks reached more brilliant heights of civilization and extended their influence farther, but lasted little more than half as long on their native land.

It is difficult to specify a date when civilization became general over most of Greece. The early history of the land is vague and confusing, as it is in all countries. There were civilized communities all along the eastern and southern coasts by 1400 B.C., and some of these civilized communities were established possibly as early as 1600 B.C. Presumably these cities were Minoan colonies; possibly they were built by barbarians who had absorbed some of the Minoan civilization. They definitely never reached the high state of civilization acquired by the Minoans on Crete.

After the destruction of the cities on Crete around 1400 B.C., Mycenae and other city-states on the Peloponnesus and the Aegean islands assumed leadership of the dying Minoan civilization. Historians usually call the two centuries following the fall of Crete the "Mycenaean Civilization," and two centuries is about as long as it lasted. It was engulfed by the hordes of barbarians that poured into Greece from the north during the thirteenth and twelfth centuries B.C.

The Ionians and Aeolians, sometimes called the Achaeans, spread over most of Greece and conquered or barbarized the Mycenaean civilization during the thirteenth and the early twelfth centuries. It was during this period that the Achaeans destroyed Troy and made piratical raids on many other areas around or near the Aegean Sea. Then the Dorians came around 1100 B.C. and conquered most of western and southern Greece, and many islands in the southern Aegean. In doing so, the Dorians drove many of the Aeolians and Ionians into the Aegean Sea, where they established many colonies in the Aegean islands and along the west coast of Asia Minor during the eleventh and tenth centuries B.C.

Little is known about conditions in Greece between the twelfth and eighth centuries B.C. This was the dark age between the fall of the Minoan and the emergence of the Hellenic civilizations, and Greek mythology and rather meager archaeological findings are the main sources of information about it.

From around 750 B.C., fairly complete records are available in connection with the wars, explorations, migrations, and adventures of the Greeks. We know many of the details of their ways of living--their politics, forms of government, trade, commerce, economic conditions, philosophy, art, architecture, amusements, eating habits, and dress. Yet we know little about their agricultural methods, even though they were primarily farmers up to the sixth century B.C. and agriculture was always considered the most honorable profession.

In a way, it seems strange that the Greek historians, philosophers, and writers should tell us so much about so many things and so little about the land they lived from and the methods they used to obtain their food. Yet it does not seem so strange when we remember that this has always been the way of historians and other writers. They usually write about the relations of human beings with each other and seldom about the relations of people to the land.

Historians are seldom farmers who have to deal directly with the problems of trying to raise crops from worn-out land. They usually live in cities and obtain their food from the market places. By the time the food supply begins to run short, a city has either developed commerce to the extent that it can import food, or its civilization has so declined that few historians or others leave any records. Thus, in ancient Greece, as in other areas, we must use modern soil science and logic to some extent in arriving at sound conclusions regarding the use of the land.

If we date the beginning of civilization in Greece around 1600 B.C., then civilized men had some twelve centuries, about fifty generations, of profitable habitation of this land. But probably fifteen or twenty generations should be subtracted from the fifty allowed the Greeks, because they were obviously barbarians with a barbaric agriculture during the four centuries (1200 to 800 B.C.) of the "Dark Age." Grazing, hunting, fishing, and piracy were the main sources of livelihood.

Farming was so sparse and crude that it probably did little, if any, damage to the land, and the same might be said of the grazing herds of cattle, sheep, and goats. It is likely that nature repaired some of the land damage done by the Mycenaeans in certain localities.

It can definitely be stated that, by the time Philip of Macedonia assumed a protectorate over Greece in 338 B.C., the land was no longer a suitable home for a prosperous and progressive civilization.

It is true that Hellenic civilization did not die with the Macedonian conquest of Greece; it simply moved to Alexandria, Antioch, Seleucia, and a hundred other cities of the Macedonian Empire, later spreading over most of the Roman Empire, into India, and to even more distant lands. Most historians call it the "Hellenistic Dispersion," which seems to be a suitable name for the Greek migrations of the last three centuries before Christ.

But we are not discussing the spread of Hellenic civilization and its contributions to the advancement of mankind; nor are we discussing the Hellenic civilization that had already spread throughout the Mediterranean and Black Sea areas before the decline of Greece. We are investigating civilized man's habitation of the Greek peninsula and the nearby islands--when, how, and why he occupied and despoiled these virgin lands. We are attempting to show that when a civilized people despoil the land on which

they live, they must either move or decline. The Greeks did both. Those who moved spread their culture over most of the civilized world and left a great heritage to mankind. Those who stayed in Greece gradually accepted a lower and lower standard of living and soon ceased to contribute anything of significance to the advancement of civilization.

It is true that many of the Greek cities were nominally independent for two centuries after Philip and Alexander assumed their protectorate over them, but this was mainly because of the magnanimity of Alexander, his Macedonian successors, and the Roman Senate. The fact that some of the Greek cities even regained a part of their past commercial importance was largely because they were located on the main trade routes--or because it took time for Macedonian and Roman cities to develop certain specialized industries in which the Greeks excelled. Athens and a few other cities remained cultural centers of the Western world for the duration of the Roman Empire, but Athens was simply a kept woman. She neither fed nor supported herself, depending partly on the patronage of such questionable philanthropists as Nero for her cultural leadership. Most of the philosophers, artists, and scholars who lived and studied at Athens after 400 B.C. were born and reared outside Greece. They came to Athens to study and work largely because of its past reputation and because it was the fashionable thing to do. Greece had already made her contribution to civilization. She was an old and decrepit invalid, living out her declining years with memories of her past.

Why should such a brilliant people as the Greeks destroy the basis for their civilization in thirty or forty generations? Many historians contend that the jealousies and wars between the various city-states particularly the Peloponnesian War of 431 to 404 B.C., caused the decline of Greece. Others advance various economic political, and moral causes for the decline. We shall not attempt to assess the relative importance of these factors. Certainly they were important. But the fact is that by the time of the Peloponnesian War most of the arable land of Greece was severely eroded and was producing only scant crops. Only in a few small areas was the land able to feed the population living there. From one-third to three-fourths of the food supply for most cities was being imported from Egypt, Sicily, the Black Sea region, and other productive areas. Greek civilization was already living on borrowed time, or, more accurately, on borrowed land, before 431 B.C. Decline was inevitable as soon as some stronger power took the "borrowed land" away from the Greeks.

A brief survey of the history of land use in Greece will show when, why, and how the Greeks despoiled their land. For this purpose, the history of civilized man in ancient Greece may be roughly broken down into three periods: (1) the Minoan and Mycenaean Age, from about 1600 to 1200 B.C.; (2) the Dark Age, from about 1200 to 800 B.C.; and (3) historical Greece, from about 800 B.C. on.

During the Minoan and Mycenaean Age, civilized communities were largely limited to the more fertile lands near the coasts. Undoubtedly the fertile valleys were farmed. The Minoans probably introduced the grape and olive into Greece around 1500 B.C., and they grew barley, spelt, and wheat on the better land. They probably grazed the hillsides to some extent, but used the sloping lands mainly for grape, olive, and fig orchards.

The Minoans and Mycenaeans depended mainly on grain, fruit, and vegetables for

their diet and used meat only as a supplement. Hence, their grazing herds probably did little damage to the land. They cut some of the forests to build ships and houses, but deforestation was confined to limited localities. We have no way of estimating just how much they depleted the land, but the damage must have been confined to relatively small areas since the Minoans and Mycenaeans never controlled more than one-third or one-fourth of the peninsula.

When the barbaric Achaeans moved in and took control of Greece during the thirteenth and twelfth centuries B.C., they largely replaced the farming culture of the Minoans and Mycenaeans with their own grazing culture. They were definitely meat eaters and hunted part of their meat supply from the wild animals of the forests. During the early centuries of their habitation, they grazed herds of horses, cattle, sheep, and goats on the pasture lands and cultivated only small areas.

Gradually, over a period of four centuries, grain and fruit became more important in their diet, and their culture changed largely from grazing to farming. This became necessary as the population increased, because the limited acreage of arable land would support more people when planted to grain than if used as pasture.

The Greeks from the twelfth through the ninth centuries B.C. depended almost wholly on agriculture for their living. No large cities existed. Trade was of minor importance, and industry was primitive, most of the tools, clothes, and other essential articles being made in the home by members of the family.

No one knows how much the land was damaged prior to the eighth century. Probably the damage was confined to limited areas. The known facts indicate that the greatest damage from erosion of cultivated fields, deforestation of the hillsides, and overgrazing of the pastures and woodlands came after 800 B.C.

There are definite signs of population pressure on the land in most sections of Greece by the middle of the eighth century B.C. (In speaking of population pressure on the land, we mean mainly the pressure on the food supply.) The inefficient methods of farming, along with the meat-eating habits of the Greeks, may have been factors in causing the short food supply. But whatever the causes, by the middle of the eighth century B.C., the Greeks were adopting the time-honored custom of colonization to relieve the population pressure at home.

For more than two centuries most of the Greek city-states solved their problem of overpopulation in this fashion. Between 770 and 550 B.C., they established colonies every place they could along the shores of the Mediterranean and Black seas. They met formidable resistance at a few places on the Black Sea, and the Phoenicians, Carthaginians, and Etruscans prevented them from colonizing certain sections of the Mediterranean coast. Aside from these areas, however, they literally made Greek lakes out of the Mediterranean and Black seas. But, since the Greeks refused to move far inland and apparently did not care to brave the tides and storms of the Atlantic, they ran out of lands that they could colonize by the middle of the sixth century B.C.

Then the Greeks followed the pattern of the Minoans and Phoenicians. They became traders, merchants, and industrialists and began to take the profitable Mediterranean trade away from the Phoenicians. From that time on, the Greek city-states were highly vulnerable.

Most of the larger cities of Greece depended on commerce and industry for a major part of their subsistence after the sixth century B.C. The Greeks traded their skill as

navigators, merchants, and manufacturers for food and other raw materials from their colonies and other nations, and they even imported a large part of the raw materials used in their many small factories. This meant that Greek ships had to be able to sail the seas without serious molestation if the Greek cities were to continue their prosperity.

Not all of the Greek city-states resorted to colonization in the eighth to sixth centuries, three notable exceptions being Sparta, Thebes, and Athens; but it is highly important to recognize that they were exceptions.

The Spartans lived in a larger and richer valley than most of the Greeks. Their land could support more people and was not as vulnerable to depletion by erosion. Furthermore, they lived inland and were not an early seafaring people. When they found that their population was outgrowing their land, they seized the land of near-by Messinia and enslaved the inhabitants. As a result they were forced to adopt the "Spartan Code," whereby all citizens became specialized warriors. Sparta never became an important industrial or commercial state, nor was the agriculture commercialized to the extent that it was in most other Greek city-states. The Spartans maintained their independence for some two centuries after most other Greek cities had bowed to the yokes of Macedon and Rome, but eventually their system of slavery and self-subsistence agriculture broke down. Then Sparta reverted to a small, insignificant village and has remained so to this day.

Thebes, also an inland town, was located in the rich agricultural plain of Boeotia where soil deterioration was not rapid. In fact, this plain, one of the few places that has fairly productive land today stands out almost like an oasis in the midst of the ruined land of twentieth-century Greece. Apparently the citizens of Thebes did not follow the great migration movement because they were not seafaring people and they still had good land at home.

The Ionians of Athens and surrounding territory had colonized many of the Aegean islands and the coast of Asia Minor in the eleventh and tenth centuries, but did not participate in the great colonizing movement of the eighth to sixth centuries B.C. They simply changed their ways of making a living and stayed at home. As the land became inadequate for their support, they shifted almost directly from a group of subsistence farmers to manufacturers and traders. They were among the first to adopt a commercial system of farming by planting a large part of their land to grapes and olives for export, and, as a result, they assumed a leading role in commerce and industry during the sixth century B.C. By the beginning of the fifth century, Athens had become the foremost city in Greece, but when her navy was largely destroyed and most of the olive trees chopped down during the Peloponnesian War, she never recovered her former place of power. She did not have the natural resources for a comeback. Only her past reputation saved her from oblivion.

Colonization and the development of commerce and industry from the eighth to sixth centuries brought an unprecedented period of prosperity to most Greek citystates during the fifth century B.C. But the Greeks, like many other peoples before and after their time, found it impossible to achieve permanent prosperity by these means.

At first, the departing colonists helped to relieve population pressure in the parent cities, and soon the colonies began producing surpluses of food and other raw

materials for export to the mother cities in exchange for manufactured goods. As long as this trade lasted, the parent cities continued to grow and prosper. But within a few generations, the colonies became commercial and industrial rivals, and, since the colonies often had greater natural resources, some of them became larger, richer, and more powerful than their parent cities. This happened to Corinth and its colony, Syracuse, in Sicily; it happened to the Phoenician city of Tyre and its colony, Carthage; and much later it happened to Britain and her onetime colony, the United States.

The exploitation of foreign lands, which usually results from colonization, can never take the place of home resources. It can be only a temporary expedient. Eventually each country must adjust its population to its resources. If a country conserves and develops its natural resources, it can continue to support a moderate growth of population and maintain a high standard of living. The improving technology of a progressive civilization enables the people to increase the production of most resources. This is especially true of soil and water resources and the plant and animal life that grow from them. But the people must conserve and improve the environment. If they exploit and destroy the land, a decreasing population or a lower standard of living--usually both must result.

By the beginning of the fifth century B.C., nearly all the Greek city-states were feeling the pinch between an increasing population and declining resources, and intense commercial rivalries began to develop between the various cities. The threat of Persian conquest, however, served to keep them political allies to some extent. After the battles of Salamis and Plataea, 480 and 479 B.C., the Persian threat was largely ended and Phoenician sea power in the eastern Mediterranean was greatly weakened. Then the commercial rivalries between Greek cities really became intense, and the Peloponnesian War was the inevitable result. Nearly all the Greek city-states were seriously weakened in both men and resources during the twenty-seven years that the war lasted. Although some cities still had enough vitality left to fight several more wars with each other during the next two generations, eventually such suicidal wars practically exhausted all of them, leaving Greece an easy prey to any aggressive conqueror. Macedonia happened to be the conqueror.

What did the Greeks do to their land from around 800 B.C. until Philip made Greece a Macedonian province in 338 B.C.? As has been stated, little is known about the condition of the land at the beginning of the eighth century. It is known, however, that a large part of the better land was in cultivation and that the trees had been cut from some of the forested hills. As the increasing population during the next three centuries demanded more and more cultivated land, the Greeks gradually pushed their cultivated fields to the hillsides that had been woods and pastures, and then tried to compensate for this loss of pasture land by overgrazing what was left and clearing more forests for grazing. These procedures were continued at an accelerated rate until practically all the tillable land had been plowed, and, unfortunately, most of this land was subject to erosion by heavy winter rains.

By the sixth century, the Greeks were draining many of the marshes at considerable effort. But they were probably creating new marshes faster than they were draining the old ones, for eroded silt was being deposited in the stream mouths near the sea. During the fifth century, the Greeks finished cutting nearly all the usable timber,

except in the sparsely settled mountainous region of the north.* They intensified their cropping methods, discontinuing the two-field system (two-year rotation) of grain and fallow that had been practiced for centuries. On much of the better land they tried to grow a crop every year, alternating grain and vegetables. And, on some of the poorer land they adopted a three-field system and alternated barley, millet, and fallow. To get water into the almost impermeable, eroded subsoil, they began irrigating where they could. (*The destruction of forests was a common practice in nearly all Mediterranean countries. Such clearing was carried to absurd lengths. Land fit only for trees was converted to pasture and cropland, only to become unfit for anything. A healthy forest provides a perpetual surplus to support human culture. An eroded, overgrazed, cutover forest on steep slopes provides practically nothing.)

Of course, the topsoil eroded rapidly from the cultivated hillsides and the cutover forest land, and the pastures fared little better. The Greeks stopped raising so many cattle and increased their herds of sheep and goats since there was hardly enough forage to maintain cattle on the overgrazed pastures. Naturally they permitted the goats and sheep to graze the remaining forests and the cutover forest land. The grazing habits of goats were discussed earlier; when overstocked on open pastures, sheep are almost as destructive as goats. Erosion was accelerated on nearly all the sloping land, and the level valley lands were covered with increasing amounts of unproductive subsoil washed down from the hills. Marshes formed at the river mouths faster than the Greek engineers could drain them, and mosquito-borne malaria sapped the strength of the people.

By the fifth century B.C., most of the Greeks had learned, the hard way, that sloping hillsides cannot be farmed long unless given adequate protection. But they failed to devise adequate soil conservation measures. Maybe they failed to realize that erosion was their chief trouble, but it is more likely that they did not have the knowledge and skill to halt the erosion process while still using the land. Apparently they were unwilling to put forth the efforts that the Phoenicians did in building rock-wall terraces on their hillsides.

The Greeks did terrace some of their sloping land, but apparently they did so more for convenience in irrigation than to halt erosion. They began to learn the value of manure, and many of them manured their fields as often as they could, but manure was scarcer as the land became poorer. Finally they realized that they could not produce enough grain, vegetables, and meat to feed their population. Also, they learned that olive trees and grape vines would produce much better on their eroded, rocky soils than would grain and vegetables. They began to plant large orchards of olives and grapes, processing the fruit into oil and wine for export to other countries in exchange for grain and other foods. This still did not give them enough food, but it helped their expanding industry and commerce to bring in enough profit to purchase additional food abroad. Thus most of Greece changed from an agricultural country to an almost wholly industrial and commercial country. Even agriculture was put mainly on a commercial basis.

The Greeks were up against the age-old problem of accelerated erosion, in an acute form. They did not have as much time as some other countries to work out a solution to their problem, and their soil, much of which was highly vulnerable to erosion, was never the best in the world. By the time they realized what was happening to their

land (erosion is not easy to recognize), it was too late.

Many historians have assumed that the soil of most of Greece has always been poor. Some have specifically cited Attica as a country that has always had poor soil. Arnold J. Toynbee, for example, states that the poverty of the soil of Attica was one of the main "challenges" that helped develop the brilliant Athenian civilization.* *(*A Study of History,* II, 37-42.) Even Thucydides, around 420 B.C., wrote: "Attica, because of the poverty of its soil, enjoyed from a very remote period freedom from faction and never changed its inhabitants."* *(*History of the Peloponnesian War.)*

Although Toynbee's theory of "challenge and response" as a potent factor in developing civilizations appeals to us in many respects, we question his conclusion that unproductive soil in Attica, or any other place, was partly responsible for the development of a high state of civilization. Toynbee himself admits that nearly all the civilizations of mankind grew on "new" land, contending, however, that a significant factor in the growth of most civilizations was the "response" to the "challenge" of breaking in the new land. We, on the other hand, suggest that the main reason "new" civilizations nearly always flourished on "new" land was that the new land was more productive. Not only does new land usually produce higher and more dependable yields, also, in most instances, it produces food of a higher nutritive value. Attica was no exception.

Thucydides was a great historian and an accurate reporter in most respects, but he was not a soil scientist. Apparently he took it for granted that the land had always been poor because it was poor in his time, but he failed to consider the probability that the Athenians had completely changed the character of the soil. When he wrote about "freedom from faction," he seems to have ignored the strife in Attica during most of the sixth century B.C., when riots, revolution, dictatorship, and near civil war prevailed.

It is just as plausible to conclude that the freedom from faction and the stability of the population of Attica, during the early centuries of Greek settlement, were due in part to the productivity of the soil; and that the faction and internal strife that started around 600 B.C. were due partly to the unproductive soil. The poor yields, heavy debts, and the consequent loss of land by many small farmers were primary causes for the "Solonian Revolution." The Peisistratus dictatorships and the Cleisthenes constitutional reforms were natural sequels.

During the period between Solon's laws and Cleisthenes' constitutional reforms (594 to 508 B.C.), Athens became a strong commercial state. Cleisthenes' reforms brought internal peace mainly because the Athenians again became prosperous. This time, however, prosperity was based largely on commerce and industry, for the soil was greatly depleted and could no longer feed the population. This civilization, resting largely on the precarious base of industry and foreign commerce and lacking a sound base of productive land to support it, was doomed to decline as soon as the Athenians lost control of the seas and their industrial competitors caught up with them.

It should be emphasized however, that the soils of Attica were not always poor. In their virgin state they were very productive. They built early Athens and started her on her path to glory, and they supported more than a score of other prosperous towns and small cities that lined the coasts and valleys of Attica. The soil became poor only after the civilized Greeks started misusing it.

The peninsula of Attica, containing about eight hundred square miles of land, is separated from Boeotia to the north by a range of rugged hills or low mountains. Several small rivers dissect the land and flow through valleys that are rather narrow except where they approach the coast. Nearly two-thirds of the land consists of rolling plains with moderate to steep slopes interspersed with rocky hills. Modern soil surveys show that, in their virgin state, most of these rolling plains had a black or red clay-loam soil of fair depth that was highly productive. Beneath this soil was a layer of soft limestone that weathered fairly fast and helped build up or enrich the soil above. On the steeper slopes, the soil was thinner but fertile.

When the Athenians first started cultivating these slopes, they had excellent yields of barley, wheat, and other crops. Not only were the yields good, but the quality of the food was high. Virgin limestone soils nearly always produce plants with a high content of those mineral elements essential to good animal nutrition, including people. Such land is highly susceptible to erosion after the organic matter has been depleted--land of this type has been almost ruined in less than one generation by modern American farmers. The Athenians' land lasted much longer than this because of their more primitive farming methods. But eventually the topsoil eroded from the slopes until the underlying limestone was practically on the surface of the ground, which is the way most of these hills are today, and which is the way many of them have been since the time of Thucydides.

Plato describes the change in the land of Attica between the time the Greeks first settled it and his age, 427 to 347 B.C., in one of his dialogues, in which Critias says: ". . . what now remains of the once rich land is like the skeleton of a sick man, all the fat and soft earth having wasted away, only the bare framework is left. Formerly, many of the present mountains were arable hills, the present marshes were plains full of rich soil; hills were once covered with forests, and produced boundless pasturage that now produce only food for bees. Moreover, the land was enriched by yearly rains, which were not lost, as now, by flowing from the bare land into the sea; the soil was deep, it received the water, storing it up in the retentive loamy soil; the water that soaked into the hills provided abundant springs and flowing streams in all districts. Some of the now abandoned shrines, at spots where former fountains existed, testify that our description of the land is true."* *(*Critias.)* Plato's discourse has a familiar ring: it sounds very much like one of our modern soil conservationists talking about some of the worst-eroded sections of the United States.

Solon, two centuries before Plato, also was aware that the soils of Attica were becoming unfit for grain farming. Around 590 B.C., he strongly advocated the discontinuance of grain farming on the sloping lands and the planting of olives and grapes.* A few years later, Peisistratus paid bounties to Attica farmers and landowners for planting olive trees. The deeper roots of the olive could penetrate the calcareous limestone, and fair crops could be made even on land that had lost most of the topsoil. Solon's remedy was inadequate because it did not go to the root of the evil-it ignored the fact that the land itself must be saved. Plato's observations were too late, even if the Athenians had had the knowledge, skill, and perseverance necessary to check erosion. (*In the fourth century B.C., Theophrastus in his *Cause of Plants* advised Greek farmers to plant grain only on the best land and to use the hillsides for trees and vines. Apparently he was just echoing the advice Solon had given more than

two centuries earlier.)

Today there is a layer of soil only a few inches deep over most of the Attica plains and hills, and limestone outcroppings protrude from the surface every few feet. Not only is there insufficient soil to raise decent crops in most places, but there is insufficient moisture in the soil to produce crops without irrigation. The soil, which is too thin and woefully lacking in water-absorbing humus, is not capable of holding enough moisture to produce a crop. The rain gets away as surface runoff. In the lower valleys there is still plenty of soil, but it is mainly erosion debris from the eroded hillsides and contains little organic matter. Furthermore, many of the valleys are marshy or waterlogged through the accumulations of silt which chokes the streams. The feeble attempts to continue raising crops from these depleted lands, together with the grazing goats and sheep, have prevented nature from rebuilding the soil.

Much of the rest of Greece had land conditions similar to those of Attica. Some areas were more mountainous and had inferior land, while others had broader valleys and better land. Nevertheless, on the whole, Attica is fairly representative of Greece and its history of land depletion.

For more than two thousands years after Philip of Macedon assumed his protectorate over Greece, the country remained an outlying province of the Macedonian, Roman, Byzantine, and Turkish empires. During this period civilization stagnated to a large extent. A majority of the people became poorer and poorer, most of them merely eking out an existence by subsistence farming on the worn-out land. During the nineteenth century, Britain, Russia, and France liberated Greece from the Turks and made it an independent nation; and these and other strong nations have continued to support its independence since that time. If they had not, Greece would probably have succumbed to conquest again. Independence brought little prosperity to Greece, however, because she did not have the resources with which to build a prosperous civilization.

In 1950, Greece (excluding Macedonia, Thrace, and Crete) had a population of about four million--less than the population of the area during the time of Pericles. And even this population is supported, to some extent, by tourists and scholars from foreign lands who go there to view and study the past glory of Greece. The standard of living of most of the Greek people has declined to a much greater extent than has the population; it has been gradually decreasing since the time of Plato. Greece is now what is generally termed a "backward area," depending on economic and technical aid from more prosperous countries to help her regain a lost standard of living.

Greece probably could not have continued to dominate the civilized world for many centuries more than she did even if the Greeks had conserved their land. The country was too small and the natural resources too meager to support a dominating world power after civilization had spread over the continent. But the Greeks could have postponed their downfall for centuries, possibly maintaining their independence permanently, if they had conserved the resources inherited from nature. And, even though they were later conquered, the people living in Greece would have been able to maintain a higher standard of living. It is a tragic fact of history that the Greeks did not direct more of their brilliant intellectual efforts toward conservation of the land that made their civilization possible.

8. NORTH AFRICA

ALL OF the Mediterranean coast of North Africa, excepting that part of Libia where the Sahara encroaches on the coastline, was an important segment of the civilized world during ancient times. Because the area that played the most important role, however, was the "hump" now known as Tunisia and Algeria, this discussion will be confined to this region. Its importance was due mainly to location, topography, and climate.

A rolling coastal plain, averaging about forty miles in width, stretches a thousand miles across the "hump" of North Africa from Tunis to Gibraltar and rises sharply inland to a dissected or cut-up plateau that is two or three times as wide as the plain. The plateau is ridged at its southern edge by the Atlas Mountains. South of the mountains is the Sahara Desert.

This region north of the Atlas ridge has a typical Mediterranean climate--winter rains and summer droughts--except that it is affected more by the hot summer winds from the Sahara than are countries on the northern Mediterranean coast. The rainfall at some points on the northern coast is as much as fifty inches a year, and at all points on the coastal plain it is ample for ordinary farming. The rainfall decreases toward the south until it becomes almost none at the desert's edge, about 150 miles from the coast on an average.

On the coastal plain, the original vegetation consisted largely of oak, chestnut, and pine trees. At the northern edge of the plateau there was a mixed vegetation of trees and grass. The trees gradually diminished until only grass remained at the foot of the mountains. On the northern slopes of the mountains, trees again became predominant. But a sparse covering of desert plants and scattered oases provided the only vegetation in the Sahara, south of the mountain chain.

The part of North Africa developed by the Carthaginians and Romans was almost equal in area to the Italian peninsula. Today this area supports less than ten million people, whereas eighteen hundred years ago it easily fed and supported twice as many, and in a much more opulent style.

The Phoenicians from Tyre established a colony at Carthage around 813 B.C. The colonists found the fertile plains a good environment. There was a fine harbor, the soils were productive, and the climate was favorable for the necessary type of agriculture--grain, fruits, and olives. The city of Carthage attained a population of about one million people at its zenith--probably the largest city that had ever existed up to that time. In contrast, near-by Tunis in 1950 had about one-fourth as many

people.
The Carthaginians developed and expanded their civilization for more than three times as long as the United States has been an independent nation. It is true that Carthage did not get all her wealth from the Tunisian hills and plains. She had many colonies, and her merchant fleet brought in much of her wealth. But it is hardly necessary to say that the soils of North Africa were rich and productive at that date. People do not build large cities in a poor land--even when a good harbor exists.
The Carthaginians were among the most skillful farmers of ancient times, so much so that when Rome conquered Carthage, the Senate had the entire twenty-eight volumes of Mago's agricultural works translated into Latin. These books were a treasure house of information on the culture of grains, olives, grapes, and other crops until they were lost with the fall of Rome.
During the heyday of Carthage, the soils of North Africa supported a civilization and populace in many ways superior to those of contemporary Rome. The land fed a great city, fed armies, navies, and a dense rural population, and there was a large surplus of food pouring off the land. Cato exhibited Carthaginian figs to the Roman Senate around 160 B.C.--figs Italy could not match--and reported phenomenal yields of grain in North Africa.

Goats against civilization. Too many goats are responsible for much of the land deterioration in Greece and other sections of the Mediterranean region. Nature cannot rebuild eroded land as long as the goat herds keep the ground stripped of vegetation.

(Photograph by F. G. Renner)

How the mighty are fallen.

ABOVE: *Ruins of an ancient amphitheater near El Djem, Tunisia that seated 65,000 people and was filled to capacity on holidays, when the Roman city of Thysdrus was there. Now only a few hundred inhabitants and their herds of sheep and goats subsist in the area.*

BELOW: *Ruins of the Roman city of Thumgadi (Timgad) in modern Algeria. This city was buried beneath the dust and sand for fifteen centuries, until French archaeologists excavated it. Note that the eroded land in the background is in a state of ruin comparable to that of the city.*

(Photographs by Walter C. Lowdermilk, Soil Conservation Service)

But, as the population increased, the Carthaginians extended their grain fields, gardens, and orchards into the hills and southward toward the desert. Aqueducts, canals, tanks, cisterns, and water-spreading devices were constructed. Winter rains were stored for summer irrigation. Wind erosion, a new problem for the Phoenicians, was encountered but partially controlled by the use of cover crops. Undoubtedly land deterioration was setting in, but the damage to the land was certainly not great at the end of Carthaginian domination of this region.

After the First and Second Punic Wars with Rome, the power of Carthage declined because she lost most of her colonies. She remained a prosperous city, however, until finally destroyed by Rome in 146 B.C. It is significant that during the last fifty years of her existence, Carthage depended mainly on the land of North Africa for her

prosperity.
The destruction of Carthage by the Romans did not destroy the prosperity of the country. The salt that Scipio sprinkled over the land around the ruins of Carthage was leached or washed away within a few years. The city of Tunis, only ten miles away, grew rapidly and took the place of Carthage until the latter was rebuilt by the Romans. North Africa remained one of the important centers of civilization and one of the great food-producing areas of the world for centuries after the defeat of the Carthaginians.
Rome paid little attention to North Africa for a century after Carthage was destroyed, except to extort a large tribute of grain annually. Then, in 42 B.C., Lepidus set out to increase the food production of this region, and the next century saw tremendous development and colonization. Great cities were built in typical Roman style, with public buildings on a grand scale, and the greatest city was Roman Carthage.
The agricultural system developed by the Carthaginians was taken over and expanded. The Romans went farther into the hills, putting orchards and vineyards on the slopes and growing grain in the valleys. In the southern, semiarid section, livestock was the principal crop. The province not only supported itself in opulent style, but contributed great quantities of food and fiber to Rome.
The Romans developed some 235 towns and cities in North Africa, in addition to thousands of villages. They built a paved highway that reached from Carthage to the Atlantic Ocean, more than one thousand miles away. The legions and auxiliaries, which secured the country from the hill and desert tribes, at times contained from 150,000 to 200,000 men. They had the same troubles with the fierce nomads that the French have had in modern times, and garrisons were necessary. To combat idleness during peaceful interludes, to exercise the engineer corps, and to get some return for the vast payroll which the legions drew regularly, the soldiers were put to work building cities and highways. Over the span of centuries such a force, augmented by thousands of slaves, could and did construct hundreds of amazing public buildings.
During this period of *Pax Romana,* the land of North Africa, like most other lands under Roman control, suffered its most serious abuse. Maximum production was the theme--more wheat, meat, wool, and oil for Rome was the principal order to each proconsul who ruled North Africa. This policy of exploiting the land of North Africa for the benefit of Rome continued for nearly six centuries--146 B.C. to A.D. 439.
The Romans did not deliberately try to ruin the land. They were probably as much concerned about its future productivity as most Americans are concerned about soil conservation in the United States today. But they wanted the bread, meat, and olive oil that North Africa produced--and they wanted these products regularly, regardless of the cost to the land. The cost was great. The land gradually declined in productivity, and, as the crop yields became scantier, the land was farmed more intensively. Cultivated fields were pushed farther and farther south toward the desert's edge, and the remaining grasslands were grazed more closely each year. Eventually the land would hardly support its own inhabitants and yielded little, if any, surplus for Rome.
Around A.D. 250, St. Cyprian, who was then Bishop of Carthage, became pessimistic about the future of North Africa. He wrote to Demetrianus, the Roman proconsul of Africa: "You must know that the world has grown old and does not

remain in its former vigor. It bears witness to its own decline. The rainfall and the sun's warmth are both diminishing; the metals are nearly exhausted; the husbandman is failing in his field. . . . springs which once gushed forth liberally, now barely give a trickle of water."* *(*Ad Demetrium,* or *Treatise to Demetrianus.)*

St. Cyprian and Demetrianus were engaged in a bitter religious argument at that time. They agreed on one point, however: that plagues and famines were coming more frequently and with more intensity. Demetrianus tried to lay the blame on the Christians' neglect of the pagan gods, and St. Cyprian refuted his charge by accusing the pagans. These men were not soil scientists, and failed to diagnose the malady properly; nevertheless, they knew that their world was crumbling around them and that the land was not yielding the bountiful harvests it had produced earlier.

St. Cyprian's account of failing crops and drying springs bears close resemblance to Plato's description of Greece some six centuries earlier. St. Cyprian was not as observant of the land, however, as was Plato, but it should be noted that he included the entire Mediterranean world in his lament about declining productivity. He had traveled widely over the Roman Empire and had observed similar conditions in other countries, though he was probably thinking mainly about North Africa when he wrote to Demetrianus.

The Vandals, having crossed into Africa from Spain, took Carthage in A.D. 439. Roman opposition was feeble, and the Vandals conquered all of North Africa with some ten or fifteen thousand fighting men, killing off the great landowners, wiping out all debts owed to Romans, and abolishing compulsory military service. Slaves were no longer slaves--and they no longer maintained some of the irrigation works and water-spreading systems. With the neglect of cover crops, wind and water erosion increased on many fields. Men must live, however, and agriculture went on as before over extensive areas.

The Vandal conquest was superficial--a "liberation," as H. G. Wells puts it.* *(*The Outline of History,* 516.) This spectacle of a territory containing several million people being taken over by a force no larger than two or three Roman legions is hard to comprehend. However, when we remember that social and economic conditions had deteriorated to perhaps as great an extent as had the land, the phenomenon becomes more understandable. Slavery, serfdom, bankruptcy of small farmers, excessive taxation, and all the other evils of a declining civilization were prevalent. Declining crop yields, malarial marshes, short food supplies, and the other handicaps that go with misused and worn-out land prevailed in nearly all communities. Hungry, malaria-ridden, and poverty-stricken farmers, serfs, and slaves do not fight to maintain the status quo.

The Vandals occupied North Africa for about a century. Then Justinian recovered it for the Byzantine Empire for a brief period. The Berbers and other desert tribes fought the Byzantines off and on for a century, and both exploited the land they controlled. The Arabs and their Moslem allies overran the region in A.D. 646. Carthage was again destroyed, by Hassan, in 698, and this time Carthage remained dead, because the land was dying.

All of North Africa submitted to the Moslems in 750. During this period of intermittent warfare, raiding, and exploitation, agriculture continued to decline. The extensive olive orchards of the Tunisian plain remained for a long time, but as the

Arabs and their Berber allies had little respect for any trees except fig and date, the olive trees gradually disappeared, probably cut for firewood or to punish farmers for failure to pay taxes.

The final destruction of the land took place in the hills, where the Berbers and other nomad tribes turned many of the formerly cultivated fields into rangeland. In all probability the range was never good, because most of the better species of grass had disappeared and the soil was already eroded severely. Wind and rain erosion was further accelerated by overgrazing, by burning the range to rid it of scrubby growth, and by cutting the remaining trees and forests. Goats and sheep eventually became the measure of the land's capacity to support life.

The case history of Utica indicates what happened to the land of this region. Utica, founded around 900 B.C., was a Phoenician colony for about a century before Carthage was founded. It was located some twenty miles northwest of Carthage, at the mouth of the Bagradas River, now called the Medjerda. This river rises in the hills of Algeria, 150 miles away, and drains several million acres that in ancient times were used intensively for both crops and grazing.

This river has a history of flooding; that is not strange, considering the heavy winter rainfall of the region. The river wanders one hundred miles through the hill lands before crossing fifty miles of the coastal plains to Utica, which was a prosperous city with a good harbor throughout all the period of Phoenician and Carthaginian domination of the region, and for most of the years that Rome ruled North Africa. But by the time the Vandals took over, the harbor was useless. It was full of silt. The Bagradas River had brought down from the farmlands and orchards such enormous quantities of soil that the sea was being pushed back. Marshes were formed near the mouth of the river as the stream was clogged with silt.

Today Utica, now called Bon-Chater, is four miles from the gulf. The marshes have filled up with silt so that large areas are plowed and cultivated, and thirty feet below these plowed fields lie the paved streets and foundation walls of ancient Utica. The river, having raised its own bed too high to flow in, having built a barrier to its own path, shifted its course, and now muddles the Mediterranean eighteen miles farther north. Such a performance in agricultural territory means just one thing--accelerated erosion.

Most of North Africa is a sorry sight today. A sparse covering of grass, which feeds a few herds of undersized goats and sheep, is the principal crop. Lowdermilk, with the discerning eye of a soil and water expert, studied this area in 1938 and reported:

"North Africa bristles with astounding ruins of opulent and populous cities and of thousands of villages and works of the Roman epoch. . . . These cities were established at crossroads and along the southern edge of the great agricultural region, devoted principally to the growing of grain and olives.

"The Roman city of Thysdrus, at the present site of El Jem, was located in the midst of the great coastal plain of Tunisia. The most conspicuous remnant there is the ruin of a great colosseum to seat 65,000 spectators. Now a wretched village stands on the site of this great Roman city. This center was supported by intensive agriculture of fields and olive orchards; but now the plain is sparsely covered with

wild vegetation and isolated groves of olives, overrun by herds of grazing animals.

"The Roman city of Thamugadi, at the site called Timgad in Algeria, was one of the more famous centers of Roman power and culture. It was established by Emperor Trajan about A.D. 100 . . . Timgad was a stately city supported by extensive grain fields in the valley plains and olive orchards on the hills.

"After the weakening of Roman power by the Vandal conquest in A.D. 439, the native Berbers captured the city, and after the Arab invasion of the seventh century it was lost to knowledge for 1,200 years, buried by dust, the product of wind erosion. Only a few columns and a portion of Trajan's arch stood above undulating mounds as tombstones to indicate that once a great city was there. . . . A wretched village of mud-walled houses sheltering a few hundred inhabitants is the only descendant of this center of Roman power and culture. Water erosion as well as wind erosion has been at work on the landscape. Gullies have been cut out through portions of the city and have exposed the aqueduct which supplied the city with water from a great spring some 3 miles away.

"Ruins of the land are as impressive today as the ruins of the city. The hills have been swept bare of a soil, a story which may be read throughout the region.

"The striking contrast between the prosperous and populous condition of North Africa in Carthaginian and Roman times and the present decadence led early students to believe that an adverse change of climate was responsible for the decline of the 'granary of Rome.' But the research of Gsell, Gautier, and Leschi discount an adverse change of climate since Roman times.

"The most telling evidence of unchanged climate in the past 2,000 years is the successful plantation of olive groves on the sites of ruins of Roman stone olive presses. An experimental grove planted at Timgad by Director Godet demonstrates that olive orchards would thrive today where the soil still remains on the slopes."* (*"Lessons from the Old World to the Americas in Land Use," *Smithsonian Report for 1943,* 419-20.)

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For the last thirteen centuries, most of North Africa has been among the backward areas of civilization. A great part of the land has supported only a nomad or seminomad culture these thirteen centuries because most of the land was incapable of supporting any other type of culture. Overgrazing by the nomads slowly but surely completed the job of turning vast areas into semidesert. The remaining soil was washed off of thousands of hills, leaving only the bedrock. The rocky slopes shed rainfall in torrents, so that gullies resulted lower down, and these gullies extended into the plains and cut them into a maze of arroyos, which acted as drainage ditches. Ground water seeped into these gullies and lowered the ground-water table. Only isolated patches of land are now fit for cultivation.

The nomads should not be blamed for the destruction of the land of North Africa, although this stock solution is advanced by many historians. As a matter of fact, the most serious phase of land destruction was brought on by the Roman system of exploitation. It was under Roman rule that the most fertile lands were stripped of their topsoil through erosion and depleted of their mineral plant nutrients through overcropping. The nomad grazing culture simply prevented nature from rebuilding the land and thus led to its final destruction.

The French, Tunisian, and Algerian governments have been attempting in recent years to restore productivity by cleaning out Roman cisterns and wells, rebuilding terraces and water-spreading structures, opening clogged springs, and planting olive groves and vineyards. But while the production and fertility of Algeria and Tunisia can be increased, North Africa will not and cannot for many centuries reach the prosperity it enjoyed in the second century A.D., even with the application of all our modern science.

9. ITALY AND SICILY

WITHOUT question the most prosperous and progressive civilization of Italy and Sicily was developed during the rule of ancient Rome, and so a great part of the discussion of the history of land use in that area will be devoted to Rome and her empire. Nevertheless, it should be remembered that most of Sicily and parts of Italy enjoyed advanced civilizations before Rome became important, and that parts of Italy and Sicily experienced brilliant chapters in history after the Roman Empire disintegrated.

From the standpoint of land use, the history of this region may be divided into seven periods: (1) the pre-Roman period, from the earliest records to about 508 B.C.; (2) the rise of Rome, from about 508 to the end of the Second Punic War in 202 B.C.; (3) the expanding empire of Rome, from 202 B.C. to A.D. 117; (4) the decline of the Roman Empire, from 117 to about 476; (5) the Dark Age, from around 476 to about 1100; (6) the Renaissance in Italy, from around 1100 to about 1500; and (7) modern Italy, from around 1500 to the present. Although this may seem a rather arbitrary division of epochs, each of these periods possessed distinctive features of land use and abuse. The main features of land use and deterioration in Italy during all seven periods will be discussed. A brief summary of land use in Sicily during the first five periods is included, but not during the last two, because the land of Sicily has contributed little to civilization since the twelfth century. Other Mediterranean lands are examined in connection with the second, third, and fourth periods, since they were so closely tied to Italy by the Roman Empire that it seems impractical to try to separate their

influences.

The Etruscans, the first-known civilized people in Italy or Sicily, probably arrived in Italy as a civilized or semicivilized people before 1000 B.C., and had developed a rather distinctive civilization by 800 B.C. Occupying most of the west coast of Italy north of the Tiber River, they, at times, controlled some of the coastal plains south of the Tiber and crossed the Apennine Mountains to establish a few settlements on the Adriatic.

The Etruscans were highly skilled engineers for their time. The Romans probably got their early training, which made them the foremost engineers of antiquity, from them, but little is known about Etruscan agriculture. They farmed the coastal plains and some of the inland areas, and apparently did not cut a great deal of the timber from the steeper hillsides.

The Greeks began to colonize Sicily and southern Italy during the eighth century B.C., and by 550 had established colonies at most places in the southern third of Italy and in eastern Sicily where natural harbors existed. The Carthaginians and other Phoenicians had established colonies at many points in southern and western Sicily by the fifth century B.C.

Greek agriculture in Italy and Sicily was similar to that in Greece, but the Greek colonists never moved far inland and confined their farming mostly to the coastal plains. They cut some of the timber to build their ships and houses, but apparently did not carry out extensive deforestation. There is no way to judge accurately how much damage they did to the land, although it is known that Greece was importing considerable quantities of grain from Sicily and lesser quantities from Italy during the fifth century B.C. Hence it may be assumed that the Greek colonists were exploiting

the land beyond their own requirements. Logic, applied to the known facts, indicates that the Greek colonists of this region set in motion the process of erosion long before the Romans ever acquired sovereignty over the land. Approximately the same conditions seem to have prevailed among the Phoenician colonies on Sicily.

Inland from the Greek and Phoenician settlements was a relatively dense population of Italians, Sicels, and other natives whose agriculture seems to have been rather primitive until the fifth century B.C. or later. No reasonably accurate estimate can be made of the damage to the land, but the density of the population suggests that they had ceased to practice shifting agriculture. Thus it may be assumed that they had induced some soil erosion, though land deterioration had evidently not proceeded far by the fifth century B.C.

According to tradition, Rome was founded in 753 B.C. For more than two centuries it remained a country town that was the main market place for a few thousand Latin farmers. Other competing towns dotted the plains and shores of Latium. During this period, usually known as the Age of the Kings, certain tribes united into a city-state with Rome as the capital, and about 508 B.C. some of the more influential warriors and chieftains, known later as the "Patricians," established the Roman Republic.

It seems safe to say that little damage had been done to the land of Latium before 500 B.C., and the meager records indicate that a part of the land had been greatly improved. The remains of drainage works constructed prior to 500 can still be seen near Rome. Apparently the Etruscans helped the Latins build these substantial underground drains on some of the nearly level land. Edward Lucas White estimates that the cost of constructing some of these drainage works at 1950 American prices would amount to at least $1,500 an acre.* *(*Why Rome Fell,* 45.)

When the Roman Republic was founded in 508 B.C., the soils of Latium were certainly productive. At this time, Rome controlled only about four hundred square miles of territory, but according to Julius Beloch, there were then 130.000 Roman citizens.* *(*Die Bevolkerung der Griechich-romischen Welt,* 312.) Since only free, adult males were eligible for citizenship, the total population must have been in the neighborhood of 400,000, or about 1,000 persons per square mile. This seems an almost unbelievable density of population, considering the fact that little industry or commerce existed in Rome or any of the other towns of Latium. Yet most historians agree with Beloch's figures--at least they all agree that the population of Latium was dense, the most conservative estimates placing it at 500, or more, per square mile.

Historians do not agree, however, on where the people got their food. Some simply ignore the fact that people must eat, while others assume that the Romans were getting large quantities of grain, as tribute, from some of the surrounding tribes of Italy. The known facts do not justify this assumption. Volscia, Hernicia, and Aequia, which surrounded Latium on the south and east, were densely populated and still independent of Rome, and it is unlikely that the Etruscans, who hemmed in Latium on the north, were paying tribute. Although the Romans may have traded the products of their meager industry for small quantities of food and exacted temporary tribute from some of the surrounding tribes at times, they must have depended on the agriculture of Latium for most of their food.

The primitive methods of Latin agriculture, combined with the density of population, undoubtedly led to intensive cultivation. The soil must have been quite

fertile and the climate dependable for growing barley, spelt, and millet, which were the principal crops of the early Romans. There are records of a few serious famines during the early history of the Roman Republic, but the number of famine years seems surprisingly small considering the density of population.

If the early Romans had not been almost wholly vegetarians, it would have been impossible for the land to have supported so many people. Indeed, it is likely that the density of the population caused the Latins to become vegetarians, for man, whether savage or civilized, is normally an omnivorous animal and seldom a vegetarian by choice. Since land will produce five to ten times as many cereal calories as meat calories, man nearly always becomes largely a vegetarian when he does not have enough land to produce adequate quantities of meat and other animal foods.

The early Romans were also frugal eaters. The Roman soldier, during the early centuries of the Republic, was issued food only twice a month, and he carried his two weeks' rations on his back, often when he went into battle. These hardy conquerors subsisted on two meals a day, composed mainly of ground barley or spelt. Not only must the soil of Latium have given dependable, high yields, but it must also have produced a high quality of food--grain that was rich in the proteins, minerals, and vitamins essential to good health. Otherwise these vegetarians could hardly have become the foremost conquerors and rulers of antiquity.

It should be kept in mind that the population of the early Roman Republic, whether it was 200,000 or 400,000, was largely rural. Most of the people who lived in Rome and the other towns of Latium were primarily farmers. The average farm in 500 B.C. consisted of one to five acres of plowland, from which each farmer produced enough food for himself and his family, with a small surplus to help feed the artisans of Rome and other towns.

During the first 120 years of the Republic, Rome remained a relatively small city. The Romans gained control of most of Latium during this time and fought many bitter wars with Volscians, Aequians, and other neighbors, but they did not expand their territory greatly. Then, about 390 B.C., they met one of their worst defeats: Rome was captured and sacked by the Cisalpine Gauls. The hardy Romans soon rebuilt the city, however, and within a few years were starting out on their conquest of the world.

Much has been written both for and against Roman conquest. It is not our purpose either to accuse or to defend the Romans, but it should be pointed out that they were following a pattern of conquest and exploitation much the same as that of the Assyrians and Persians, who came before them, and the Arabs, Mongols, Spaniards, French, British, and others, who came later, and that their pattern differed but slightly from that of the Greeks, Phoenicians, and Minoans. There are two significant differences, however, in the exploitation of other lands and peoples by the Romans and the Greeks and Phoenicians: The Romans employed conquest instead of colonization to acquire more land, and they conquered and exploited more extensive areas than their predecessors on the Mediterranean scene.

ABOVE: *Patchwork farming on the western slope of the Apennines. The scarcity of good land forces modern Italian farmers to cultivate every patch of hillside that can be farmed. Note, however, that a large part of this land is planted to vineyards. Modern Italians have doubtless learned, as the ancient Greeks and Romans did, that steep hillsides with poor soil will produce better crops of grapes than grain.*

BELOW: *Rocky mountains will not produce grain, but may produce grapes. These grape vines are growing in the clefts between rocks on a hillside of Italy. The ancient Greeks and Romans often resorted to grape and olive farming on land that had lost its topsoil and was too rocky for grain production.*

(Photographs by Glen E. Riddell, Soil Conservation Service)

Hauling soil back up the hill. These French farmers haul the soil from the bottom furrow to the top of the field each winter. This helps compensate for the downhill movement of soil by erosion.

ABOVE: *Loading soil into the cart.*

BELOW: *Distributing the soil.*

(Photographs by Walter C. Lowdermilk, Soil Conservation Service)

The differences between colonization and conquest, however, are only differences of degree, as each procedure is used largely to obtain more land and resources. The action is called colonization when the aggressors take land away from a relatively sparse population of savages or barbarians, and conquest when the aggressors take land away from a relatively dense population of civilized people. Many cases fall between these extremes. Regardless of conditions, however, the aggressor generally refers to his act as colonization, and the native calls it conquest.

It is worthy of note, also, that in colonization the aggressor as a rule drives off or exterminates most of the native inhabitants and thus has almost sole use of the resources he has taken. In conquest, most of the native inhabitants remain on the land,

either enslaved or subjected to tribute, and the aggressor has only partial use of the resources he has taken, for he must share at least a subsistence living with the conquered people who remain.

The Romans probably pursued the path of conquest rather than colonization more from necessity than from choice, for by the time they appeared on the scene, most of the desirable lands around them were already occupied by people who were fully as civilized as they. They did, nevertheless, make use of colonization to a limited extent. During the fourth and third centuries B.C., they sent colonies to a number of defeated states in Italy, where the population had been severely depleted by war or enslavement, and, during the last two centuries of the Republic and the first centuries of the Empire, they sent colonies to provinces outside Italy. At no time, however, did the Romans colonize conquered lands on a scale comparable to the Greek and Phoenician colonizations.

The density of the population of Latium was undoubtedly a major factor in starting the Romans on their road to conquest. They began by conquering some of the bordering states, probably during famine years when the hungry citizens desired both the food and the land of their neighbors. These first conquests were so successful that soon they were attempting to conquer the whole of Italy, and, with a few minor setbacks, they succeeded in their quest, bringing all of the Italian peninsula south of the Po Valley under their rule by 272 B.C.

It was during this period that the Romans set the pattern for their later conquests by not attempting to kill or enslave all of the inhabitants of the conquered lands, as was the general custom of the time. They enslaved some of the humbler people of the country, but tried to make allies of the more important warriors and landowners--on many of whom they conferred all the rights of Roman citizenship, except the right to vote--and then exacted tribute from them. The descendants of many such warriors later served in the Roman armies and helped conquer the rest of the world.

After gaining control of most of Italy, inevitably Rome came into conflict with Carthage, the other major power of the western Mediterranean. During the Punic Wars, the relative leniency of Roman conquest terms paid off handsomely, for many of the conquered people of Italy remained loyal to Rome during one of her darkest hours--when Hannibal was defeating one Roman army after another and ravaging most of Italy. All of the resources of the Romans and their Italian allies were barely enough to defeat Carthage, and these resources were seriously depleted during the struggle.

Much of the farm land of Italy had undoubtedly suffered severe erosion before the beginning of the Punic Wars. Although the growth of population had caused the clearing of steeper and steeper slopes for field use, the wars helped speed up the process of land destruction in a number of ways. Much of the usable timber was cut from the Apennine Mountains and foothills to build the huge fleets of warships that Rome sent against Carthage and the Illyrian pirates from 264 to 202 B.C., and much of the farm land was abandoned because the farmers were serving in the army or were killed in battle. In addition, during his fifteen-year campaign in Italy, Hannibal overran many of the farms with his armies, thus causing more land abandonment. Where erosion is already underway, abandoned land continues to erode for several years before natural revegetation halts the process.

After the Second Punic War, some of the formerly cultivated land of central and southern Italy was not farmed again until modern times. It had already lost much of its fertility through erosion and overcropping and, once abandoned, was slowly taken over by weeds and brush or, if located on the coastal plains, became waterlogged and marshy. Some abandoned fields were reclaimed, but usually they were planted to grapes or olives or were used as pasture.

At no time from the end of the Second Punic War until the fall of the Roman Empire did Italy produce enough grain to feed its population. In fact, the Romans were importing grain from Egypt before the war was over. After Carthage was defeated, Sicily, Sardinia, eastern Spain, and eventually North Africa were added to the empire, and large tributes, in the form of grain, were exacted from Sicily and North Africa and, to a lesser extent, from Sardinia and Spain. Even so, the tribute was often inadequate, and the Romans found it necessary to purchase considerable quantities of wheat from Egypt and the provinces.

It is significant that the first records of malaria as a serious disease in Rome date from about 200 B.C., for the prevalence of malaria usually indicates the presence of swamps or marshes. Some of the almost level plains of Latium, which had supported a population of five hundred to one thousand people per square mile three centuries earlier, had undoubtedly become marshy by 200 B.C. The famous Pontine Marshes, a large marshy area near the mouth of the Tiber that had supported sixteen Volscian towns around 600 B.C., were largely created during this period. As the Latins and other Italians cleared and cultivated the sloping lands in the watersheds above, the drainage works that the Etruscans had helped install were clogged with silt, and the fertile, flat lowlands, largely immune to erosion, were rendered unproductive by the deposit of erosion debris from the uplands.

By 200 B.C., the Romans and those preceding them in Italy and Sicily had reduced the productivity of the land to an alarming extent. At this point, the land of central and southern Italy was probably in somewhat the same condition as the land of southeastern United States in 1930. Only a vigorous and widespread conservation program could redeem the land and bring it back to anything approaching its former productivity.

The Romans should not be blamed for all the land deterioration, for these lands had supported Etruscan and Greek civilizations for several centuries before the Romans acquired control of them, and, furthermore, the Romans themselves never farmed much of the land outside of Latium. Roman responsibility lies in the fact that they exacted such heavy tribute and taxes that the native farmers were forced to exploit the land more intensively than they might have done otherwise.

The land of northern Italy, from the Po Valley north, should be considered in a separate category since it did not come completely under Roman domination until around 150 B.C. The Cisalpine Gauls practiced agriculture of a sort in the Po Valley before that, but they never farmed the land intensively enough to cause serious damage. The Romans did not bring their system of agriculture to the rich Po Valley until after they had already established Sicily, North Africa, and other provinces as their principal granaries. Therefore land damage came later and much slower, and the soil never reached the point of exhaustion that it did in central and southern Italy.

The agriculture of Italy was gradually revolutionized during the second and first

centuries B.C. The number of small farms decreased, while the large farms and country estates, known as *latifundia,* increased in both number and size. The acreage planted to grain decreased greatly, and the acreage planted to grapes, olives, and fruits increased. The number of livestock also increased because a large part of the former grain land was converted to pasture. A considerable amount of farm land was abandoned because it was no longer fit for either farming or grazing.

All the economic, social, and political factors that helped to change Italian agriculture will not be considered here, but a few are worthy of note.

Up to the first century B.C., the Roman Republic depended mainly on the small farmers of Italy for its soldiers, who were frequently taken from their farms for extended periods. Hardly a decade passed in which the Republic was not engaged in one or more wars, sometimes civil wars. Many citizens, finding it impossible to care for their farms properly, either sold or abandoned them and became professional soldiers.

Certain other inducements led many small farmer citizens to leave the land and move to Rome. Citizens were entitled to vote only if they were in Rome at the time of an election. They could often sell their votes and could obtain free admission to the circus, gladiatorial contests, and public baths. Furthermore, from the time of the Punic Wars on, the state sold grain to citizens in Rome at half the market price, or less, and in 58 B.C. began to give them grain and other food.

The huge spoils of war that almost continuously poured into Rome made millionaires of many Roman senators and other citizens. Since senators were forbidden to engage in commerce, they usually invested in land, and during the latter years of the Republic many of them acquired one or more *latifundia.* Senators and many other rich Romans acquired these large estates, which were usually operated as commercial farms and worked by slaves, the produce consisting mainly of wine, olive oil, fruit, poultry, and livestock.

Some historians contend that the huge imports of grain, exacted as tribute from Sicily, North Africa, and other provinces were primarily responsible for the decline of grain farming in Italy, and point out that this grain was sold at half-price or given away to citizens in Rome, thus destroying the principal market for Italian grain. Their contention will hardly stand close analysis, however, because the Romans were also buying grain from Egypt, Sicily, North Africa, and other provinces and were selling it at less than half the purchase price. Had the grain farmers of Italy been able to compete with the Egyptian and provincial farmers, undoubtedly the Roman government would have purchased Italian grain rather than importing it. Rome must have been forced to import grain, either as tribute or as a purchased commodity, because Italy was no longer producing enough to feed its population.

By 131 B.C., the plight of the small Italian farmer had become so serious that the Gracchi brothers attempted their agrarian reforms, the most important feature of which was the division of all state-owned land into small farms for distribution to worthy citizens. At this time, most of the state-owned land was being farmed or pastured by rich patricians, who paid only a nominal rent to the state. The reforms, however, met with little success, and both the Gracchi lost their lives in trying to enforce them.

The principal fault of the Gracchi reforms was that they did not get to the root of the

problem. Like many other well-meaning politicians before and after them, the Gracchi were attempting to correct physical defects by social legislation. Apparently they did not understand that deterioration of the land was one of the main things wrong with Italian agriculture. Furthermore, most of those who received grants of land under the Gracchi Laws soon sold their land and went back on the state dole in Rome. Giving a farmer a few acres of worn-out land will not make him a prosperous and patriotic citizen.

An intensive program of conservation and land improvement was essential in the second century B.C. to restore Italian agriculture to its former state of productivity. Such a program was not started, and agriculture continued to decline. This decline was one of the fundamental causes of the numerous civil wars and dictatorships during the last century of the Republic, and it can even be considered one of the main reasons for the fall of the Republic and the accession of an Imperator in 30 B.C. The farmer citizens who moved to Rome, together with foreign artisans and tradesmen and the large number of freed slaves, formed an unhealthy mass, and it was this rabble and some of the more or less unscrupulous leaders who mainly fomented the civil wars, which resulted in dictatorship.

After Rome acquired an emperor, the civil wars ceased for two centuries. During the first century and a half, the boundaries of the empire continued to expand. As long as new lands were added to the empire every few years, the supply of war booty and slaves continued to pour into Rome and new food-producing areas sent their tribute to feed the people of Rome and other Italian cities. As a result there was an unprecedented era of prosperity, which was even extended to the provinces. This relative prosperity over most of the Mediterranean region can be ascribed by and large to the fact that this was one of the few periods in history when most of the civilized world was at peace. It was also the period when the land of the Mediterranean region was exploited most intensively.

By A.D. 117, when the Empire ceased to expand, Rome and some other Italian cities not only imported most of their food, but also imported most of the manufactured articles used. There was little industry of any consequence in Rome or other Italian cities; the little that existed was carried on primarily by slave labor, and the articles manufactured were usually poor in quality.

Most of the grain that fed the population of Rome came as tribute from Sicily, North Africa, Egypt, and other provinces, and the remainder was purchased, largely from the provinces. Most luxury articles and many of the manufactured necessities were imported from the eastern provinces, while Rome and Italy exported little to these provinces, paying for purchased goods largely from spoils seized from newly conquered countries and from taxes assessed on older provinces. The more the Romans extended their empire, the more vulnerable they became, and, when they failed in conquest or lost control of a substantial part of their provinces, downfall was inevitable.

The agriculture of Italy continued the same trend during the Empire as during the last two centuries of the Republic. By Hadrian's time, A.D. 117, nearly all the arable land within two days' traveling time of Rome, and a substantial part of that in all Italy, was included in *latifundia.* While most of the productive land was used for growing grapes and olives, except for small areas close to Rome and other cities that were

planted to vegetables, the less productive land was used mainly for pasture and grain growing continued to decline. Finally some of the *latifundia* did not even produce enough grain to feed the slaves that worked them, and it became necessary to import grain for this purpose.

The decline in grain production was not confined to Italy. The grain shortage over the Empire became so acute by the time of Domitian (A.D. 81 to 96) that he issued an edict that forbade the planting of grapes in Italy and ordered each landowner in the provinces outside of Italy to destroy half of his grape vines. He was unable to enforce this edict and eventually repealed it; but even if he had enforced it, it is doubtful whether he would have materially increased the grain supply. He probably would have just speeded up the rate of land abandonment.

Most farmers grew grapes or olives because grain was no longer profitable. It is much simpler to plant a crop of grain and harvest it in a few months than to plant a vineyard or an olive grove and wait several years for a harvest; but if the land is so eroded and exhausted that it will no longer produce profitable crops of grain, it is necessary to turn to some other crop or quit farming it. Italian farmers were doing both.

It is safe to say that little additional damage was done to the land of central and southern Italy during the five centuries of the Roman Empire domination, for the greatest damage had been done before that time. The Roman system of agriculture was introduced to the Po Valley and northern Italy, but this area was never subjected to the abuse imposed on the land farther south. The Romans did not depend on the land of Italy for their subsistence during these centuries, and their policy of importing most of their food from the provinces was a primary factor in, preventing the complete deterioration of Italian soils. Thus the land of Sicily, North Africa, Syria, and other provinces suffered the greatest damage under Roman exploitation.

Historians have written many volumes about the decline and fall of the Roman Empire, and each has his own theories about why Rome fell. Edward Gibbon believed that the fall was a triumph for Christianity and barbarism* *(*The Decline and Fall of the Roman Empire.)* E. L. White also lays much of the blame on the Christians, but he cites many other contributing causes, among them "the exhaustion of the soil of Italy, Sardinia, Sicily, and Roman Africa."* *(*Why Rome Fell,* 261.) Karl B. Mickey, who believed that land damage was an even more important factor in the fall of the Empire, stated: "Before the fall of the Western Roman Empire, in A.D. 476, the agricultural regions of Italy and the provinces were nearly depopulated. Part of the depopulation was due to low birth rate and the rest to the abandonment of the land by its cultivators. Efforts were made to stem the trend, by paying bounties to parents for each new birth and by passing laws binding both the slaves and coloni (free tenants) to the land. But all efforts failed; the exhausted, eroded soil simply could not support the population and the terrific weight of imperial taxation."* *(* Man and the Soil*, 38.) Toynbee, who suggests that the fall was indicated before Rome ever became a world power, sees the Roman Empire as the "universal state" of the Hellenic civilization, and contends that the Hellenic civilization ceased to grow and started to decline at the time of the Peloponnesian Wars, 4311 to 404 B.C.* *(*A Study of History*, VI, 287-91.) Other historians list a variety of reasons, among which moral decay, political corruption, economic maladjustment, and malaria are paramount.

It is not surprising that this great empire gradually disintegrated, but it is amazing that this conglomeration of widely diverse peoples and lands held together as an empire for such a long period. The Roman Empire began to decline during the reign of Hadrian, A.D. 117, when its boundaries ceased to expand, but it was held more or less intact for nearly a century by the fortunate succession of a group of strong emperors. But with the death of Commodus, A.D. 192, Civil wars again became prevalent.

Septimius Severus, a Semitic general from Carthage, became emperor in A.D. 193, and this might well be accepted as the date on which the city of Rome fell from its high eminence and Italy became just another province in the vast empire. For the next century, the proud Romans were ruled mainly by Semites and Orientals, and the Roman armies were composed entirely of soldiers who came from outside Italy, because Severus had forbidden all Italians to serve in the armies of the Empire. Yet the system of government was so constituted that Rome continued to be the capital of the Mediterranean world for another century.

For all practical purposes, the city of Rome and most of central and southern Italy ceased to be important to the Mediterranean civilization during the reign of Diocletian, A.D. 284 to 305, who moved the capital of the Empire from Rome to Nicodemia in Asia Minor, thus dividing the Empire into two segments, with the capital of the western segment at Milan in northern Italy. Only for brief intervals thereafter was the Empire consolidated, and seldom was Rome the capital of even the western segment. It was more than a century later that Alaric, the Goth, and then the Vandals sacked Rome and carried away or destroyed most of the famous art and architectural works, and it was nearly two centuries after Diocletian that the Western Empire finally collapsed in A.D. 476, when Rome became just another city of the Gothic kingdom. in Italy. But these centuries were a period of stagnating civilization over the southern two-thirds of the Italian peninsula.

We are not particularly interested in why the Roman Empire fell--except for the unquestionably important part played by soil erosion and other forms of soil depletion, which were prominent among the fundamental causes for the final collapse of civilization over most of the Western Empire.

During the last years of the Republic, around 60 B.C., the philosopher and poet Lucretius, who recognized the effects of erosion and the seriousness of soil exhaustion in Italy, believed that the earth itself was dying, that the land was becoming exhausted, while the rains and rivers were eroding it and carrying it into the sea.* *(*De Rerum Natura.)* He observed that the farmers had to farm more land and work harder than their ancestors to raise enough to support themselves. Lucretius had good reasons to be concerned about soil erosion and exhaustion in Italy, because by his time a great part of the land south of the Po Valley was relatively unproductive.

In the first decade A.D., Livy wondered how the vast armies of the Volscians, Aequians, and Hernicians, that the Romans had fought four centuries earlier, were bred and supported.* *(*History of Rome.)* In his day, the land of these regions was so poor that it supported only a small population, principally of slaves who tended their masters' herds of livestock and cared for the sparse groves of olives and vineyards. Livy was a historian, not a soil scientist, and thus had difficulty understanding how erosion and other forms of soil depletion had robbed the land of its original fertility.

It has already been related that St. Cyprian of Carthage, around A.D. 250, moaned that the world was dying, the farmers failing, the springs drying up, and famines increasing all over the Mediterranean region. These three are but a few of the many who must have noted the decline in the land's productivity. Their observations have come down to us because they were distinguished writers of their age. Undoubtedly most of the hard-working farmers, who were trying to wrest a living from impoverished soil, had still more positive ideas about how the land was wearing out, but they seldom expressed their beliefs in writing.

Unfortunately, too many of the statesmen who governed the Empire failed to recognize the real problem. They tried to bolster agricultural production with various types of economic and social legislation. Pertinax, in A.D. 1193, offered to give ownership of any abandoned land in the Empire to anyone who would occupy and cultivate it, agreeing to exempt such land from taxes for ten years, but he found few takers who were willing to homestead the eroded, worn-out, abandoned land scattered over Italy and many of the provinces.

Diocletian, A.D. 284 to 305, attempting more drastic measures to stimulate production, issued an edict that bound all free farmers and slaves to the land which they were supposed to cultivate. This was the beginning of the *coloni* system that eventually led to medieval serfdom. Constantine, a generation later, clarified Diocletian's edict and attempted to enforce it more vigorously by making it a crime for the son of a farmer to leave the farm on which he was reared.

It is needless to say that all such efforts to bolster agricultural production failed. As the rural areas over most of the Empire gradually became more and more sparsely populated, the food supply diminished and the cities declined in population.

Bishop Dionysius of Alexandria, around A.D. 260, estimating that the population of Alexandria was less than one-half of what it had been, mourned to see "the human race diminishing and constantly wasting away."* *(*Letter to Heirax.)* The Bishop correctly described a condition that existed not only in Alexandria, but in most other cities of the Roman Empire and in the rural areas. The population was decreasing, and the decrease accelerated from the second to the fifth centuries. Why?

Some historians blame the great plague of 166-67 for the population decrease, others blame celibacy, birth control, wars, moral decay, and various other factors, while still others try to show that the widespread prevalence of malaria was mainly responsible. All of these things played important parts, but the primary, fundamental cause for the decline in population was the food shortage.

Untold millions died during the plague of 166-67. Certainly the population was decimated in most cities and the loss of life was serious in rural areas, but many cities, states, and empires have survived worse plagues and showed an increase in population within a few generations. War and pestilence have never been known to cause a permanent decrease in the population of any large area, unless they have contributed to a permanent decrease in the food supply.

Celibacy, voluntary birth control, moral decay, and other social forces undoubtedly influenced the declining birth rate, but were these fundamental causes? Such social diseases have a way of correcting themselves in any area where resources and food are ample to support a healthy, well-fed population. Malaria unquestionably contributed to the decline in population, but mainly as it affected the food supply by

driving farmers from some of the most productive land.

Depopulation started in the rural areas, and this, of course, resulted in a decrease in the food supply, which caused a decrease in the cities. In other words, the farmers of the Roman Empire ceased to produce the surplus necessary to support their cities, and the decline in civilization was inevitable.

When land becomes eroded and unproductive, farmers must work long and hard to raise enough food for their own consumption, with a meager surplus for sale. Then, if a high rate of taxation is added to their burdens and a relatively low price is set for their salable surplus, as in the Roman Empire, the farmers can hardly be expected to continue to farm their land if they have any other choice; and those who do continue to farm are likely to do so with little zeal, and they will produce only a small surplus for city consumption. This was essentially the condition of most of the farmers of the uplands in Italy, Sicily, North Africa, parts of Spain, Syria, and many other Roman provinces during the last centuries of the Empire.

The farmers of the coastal plains and valleys were not confronted with the erosion problems to the extent that the hill farmers were, but they had other problems that in some respects were more serious. They had to contend with the high silt loads that came down all the streams and waterways and caused increasingly difficult drainage problems and often converted the valley lands and plains into marshy swamps. Then malaria nearly always became a serious and persistent disease, forcing many farmers of the coastal plains and valleys to desert their farms.

A good example of the ravages wrought by man-induced erosion and subsequent malaria infestation is found in Paestum, which also serves as an example of the depopulation of parts of Italy during the last centuries of the Empire and medieval times.

Paestum, located on the west coast of Italy, about twenty-five miles south of present-day Salerno, was founded about 600 B.C. by the Greeks and named Poseidonia, after their god of the sea. For about three centuries it was a thriving Greek city. The Greeks built three magnificent temples, the ruins of which survive today, one of them rivaling the Parthenon of Athens in size and grandeur.

Annexed by Rome and renamed Paestum around 273 B.C., the city remained an important seaport and commercial center for another two centuries. During the first century B.C., malaria became a serious pestilence in and around Paestum. While uncontrolled erosion debris from the highlands obstructed the streams and drainageways and created marshlands out of large areas of the once fertile coastal plains, silt clogged the harbor and eventually rendered it useless. Paestum gradually declined as a city and by the end of the Roman Empire was only a small village with magnificent ruins of Greek temples.

Paestum continued to exist as a small village until the ninth century, but after that all the inhabitants seem to have left, and the area remained deserted for eight hundred years. Throughout all of latter medieval and early modern history, no mention is found of the Greek ruins at Paestum.* (F. N. Pryce, "The Greek Temples of Paestum," *Wonders of the Past,* II, 997-1004.) Apparently the marshes and malaria were so forbidding that few people even ventured into the area. The Greek ruins were rediscovered in 1740, but the area remained uninhabited until the twentieth century. During the 1930's the Italian government started draining the marshes and reclaiming

the land for cultivation.

There is no reason to assume that the depopulation of Paestum was an exceptional case. Historical records indicate that a majority of the coastal-plains cities of the Mediterranean suffered fates similar to Paestum during Phoenician, Greek, and Roman times.

Besides Lucretius, St. Cyprian, and Bishop Dionysius, there were many Roman citizens who thought that the world was dying and the human race wasting away, because they saw their land and their empire dying. All of the land of the Roman Empire, however, had not been despoiled to the point of exhaustion. It is true that a large part of Italy south of the Po Valley, most of Sicily, considerable portions of Sardinia, Spain, southern Gaul, and Dalmatia, and some of the land in other provinces had been seriously depleted and had become unfit for farming, according to Roman standards. The exhausted condition of the soils of Greece, North Africa, Syria, Lebanon, and Palestine has already been discussed. But there were still large areas of productive land in the Empire when Roman civilization succumbed.

Most of the land of the Po Valley had not been seriously damaged when the Roman Empire fell, and central and northern Gaul, Britain, and Central Europe still had plenty of good land to feed the Western Empire, had it been farmed properly. These fertile lands formed the basis for the modern European civilization which gradually emerged from the ruins of the ancient Roman civilization.

Parts of Asia Minor still had productive land, Egyptian soils were still fertile when barbarism engulfed the western Mediterranean region, and much of the land of Eastern Europe retained most of its virgin productivity. These lands formed the principal basis for the Byzantine civilization that continued to survive after the Western Roman Empire fell.

But most of the provinces with considerable amounts of good land were located on the outskirts of the Empire and were subject to constant harrassment by barbarians as Roman military power weakened. The lands from which Rome was largely built, the once fertile coastal plains of Latium, Campania, and Tuscany and the rich plains and highlands of Umbria, were now mainly wasteland and eroded, rolling plains that were largely unfit for farming. These were the lands on which Rome had to depend as she lost military control of the more distant provinces.

After the capital of the empire was moved from Rome, population of the city gradually declined. Rome did not pass into oblivion as did Nineveh, Carthage, Paestum, Corinth, and Antioch or become an insignificant small town, mainly because the Catholic church made Rome the religious capital of western Christendom during the Middle Ages.

The Romans did not ignore completely soil and water conservation in the lands they were exploiting. They built cisterns to catch winter rain for summer irrigation, constructed water spreaders, and terraced many of the sloping fields of North Africa; they improved the irrigation works of Syria and installed new irrigation systems in many areas of low rainfall, and built terraces and irrigation systems in parts of Italy, Sicily, and other provinces. The chief trouble with their conservation measures arose from the fact that the engineers dominated most Roman conservation work. Although they sometimes practiced crop rotation and occasionally used manure as a fertilizer, the Romans never conceived the idea of using the land according to its capabilities.

They, like many modern Americans, assumed that you can control water and soil erosion largely with engineering structures.

Cisterns, dams, terraces, an d water diversions are all good conservation structures when used in the right place and in the right way, but they are only supplements to good land management and, at best, conserve only a part of the water and soil. Furthermore, they must be constantly maintained and repaired, because nearly all such structures tend to concentrate water and are highly susceptible to destruction by the water they are supposed to control. With a few years of neglect, such structures usually break down, and then erosion from the concentrated water becomes worse than if the structures had never been built. This means, of course, that such conservation structures lose their effectiveness when the land is abandoned or overrun by barbarians who do not maintain them. That is what happened to most of the soil and water conservation structures built by the Romans. Many fell into ruin because of neglect and land abandonment by Roman farmers, and others disappeared within a generation or two after the Goths, Vandals, Franks, and other barbarians took over the lands of the Empire.

The Dark Age was not so dark over most of Italy as in other parts of Western Europe, yet there were five or six centuries after the fall of the Western Roman Empire when life was so chaotic and insecure that civilization continued to regress. The best we can say is that the invaders, conquerors, and despoilers were not quite so numerous and barbarous as those who overran most of Western Europe.

The Byzantine Empire nominally ruled most of central and southern Italy for about three centuries after the Western Empire fell, and it ruled parts of southern Italy off and on until the eleventh century. These lands were the outposts of the Byzantine Empire, however, and were subject to frequent raids by barbarians. The pope at Rome gave considerable protection to central Italy for a while, because most of the barbarians were Christians and respected his authority, but in the ninth century, the Moslems from Africa and Spain began their raids on Italy. They did not respect the authority of the pope, but they never gained control over much of the peninsula, merely ravaging the country and leaving--to return for repeated raids at frequent intervals.

These frequent invasions and raids by barbarians and Moslems prevented any type of sustained and progressive agriculture over most of western and southern Italy, which was fortunate for the land, since much of the farming reverted to a shifting type of subsistence agriculture. Nature doubtless helped to restore a part of the former fertility of the land in some areas during these centuries of neglect by civilized men, but she did not restore the land to anything like its virgin productivity.

Northern Italy did not experience raids by the Moslems, but felt the full fury of the invasions of the Goths, Franks, Lombards, and other barbaric tribes. It reverted to a barbaric kingdom, sometimes divided and sometimes united, where the barbarian agriculture permitted some recovery of the land by allowing it to remain uncultivated for a few centuries.

Sicily, also under nominal control of the Byzantine Empire for about three centuries after the Western Roman Empire fell, suffered the same type of exploitation under the Byzantine emperors that the Romans had carried on, but the exploitation was on a much reduced scale now, for the land was not producing much surplus.

In the ninth century, the Moslems started invading Sicily, eventually conquering the entire island. This was the beginning of the last period of glory for Sicily. The Moslems instituted their semiarid type of agriculture on the land of Sicily, coaxing another two centuries of profitable production from the tired land. They did not export the surplus to foreign capitals, but used it to build a few magnificent Moslem cities on the island, the most famous of which was Palermo. For the first time in its history, Sicily was a united and independent nation, relatively prosperous by contemporary standards. But this Moslem revival lasted only about two centuries.

Toward the end of the eleventh century, the Normans wrested control of Sicily from its Moslem rulers and attempted to institute their system of feudalism in the island. For a few generations thereafter Sicily remained an important area, mainly because of the fusion of Norman aggressiveness with Moslem science and agriculture, but the formerly rich land had been abused for so long that it refused to produce the bountiful crops of ancient years. Decadence of civilization set in like a creeping paralysis.

A few patches of really productive land may still be found in Sicily, and other broad stretches are still farmed--but the produce is meager. Some Sicilian farmers now claim that their main problem is lack of rainfall, yet the records show that the annual rainfall is from twenty to fifty inches a year, with an average rainfall for the entire island of about thirty inches. Sicily still supports a population of approximately four hundred per square mile, but most of the people are poverty ridden, with an inadequate diet. In other words, a great part of Sicily is another well-rained-on desert.

Barbarism and feudalism almost engulfed northern Italy during the fifth to eleventh centuries, but not quite. A number of cities survived and remained more or less independent throughout the Dark Age. Most of them were conquered repeatedly by the Goths, Huns, Lombards, and others, while some were destroyed one or more times, but were rebuilt. Much of the farm land was abandoned, but most of that near the cities was kept in cultivation. Life remained secure enough for the farmers to till their fields by day and seek the security of numbers in the cities by night.

By the eleventh century, such cities as Venice, Milan, Genoa, Pisa, Florence, and Verona had become independent city-states. During the next three centuries most of these cities became thriving and prosperous centers of trade, controlling nearly all the trade that passed between the Near East and feudalistic Western Europe. Their prosperity was not based entirely on trade, however, as most of them had fairly large surrounding areas of good farm land, from which they got most of their food and a substantial part of their wealth.

It should be emphasized that the center of Italian civilization did not shift from central to northern Italy during the Middle Ages, but during the declining years of the Roman Empire. Diocletian moved the capital of the Western Roman Empire from Rome to Milan around A.D. 300, and the capital remained at Milan, Ravenna, or some other northern city as long as it was located in Italy. When Theodoric became the Gothic king of Italy, A.D. 476, he located his capital at Verona, not Rome. This shift of the seat of government was made primarily because northern Italy was the only part of the peninsula that was producing enough food to support its inhabitants. During the second century A.D., when farms were being abandoned all over central and southern Italy because of soil impoverishment, Plutarch wrote of the region now

known as Lombardy as follows: "All the country is planted with trees, has pleasant and rich pastures and is well watered. It contains eighteen large cities well situated for trade and for obtaining all the accommodations and pleasures of life."* (*"Camillus," *Plutarch's Lives.)*

The inherent fertility of the soil deteriorated little, if any, between the fifth and eleventh centuries. As has been stated, the abandonment of considerable areas by the cultivators served more to increase than diminish the productivity of the soil, and, in the eleventh century, a great land-reclamation program that endured for the next two centuries was started in most sections of northern Italy, where large areas of abandoned land were reclaimed for cultivation by clearing or drainage.

By the thirteenth century, most of the arable land of northern Italy had again been brought into cultivation. The cities were prospering, even though they were often fighting each other and occasionally engaging in wars between the emperor of the Holy Roman Empire and the pope. In describing northern Italy of the thirteenth century, Sismondi says: "The aspect was of a prodigious prosperity which contrasted so much with the rest of Europe that nothing but poverty and barbarism was to be found elsewhere. The open country appertaining to each city was cultivated by an active and industrious race of peasants . . . . Men who meditated and applied to the arts the fruits of their study, practiced already that scientific agriculture of Lombardy and Tuscany which became a model to other nations."* (*Jean C. L. Sismondi, *History of Italian Republics,* I, 78-9.) It was in this setting of productive farms and prosperous cities that the Renaissance of literature and art took place in the fourteenth century.

The Renaissance was the last brilliant chapter in the history of Italy. The tired land of the southern two-thirds of the peninsula had long since become incapable of supporting a prosperous and progressive civilization. The Renaissance period, of some four centuries, took its toll on the rich lands of the Po Valley, and by the end of the fifteenth century, these lands were also becoming tired and exhausted. As Western Europe emerged from its Dark Age, it became less dependent on the commerce of the Italian cities, and when Columbus proved that Atlantic Ocean travel was feasible, the Italian cities were cut off from the main trade routes. Their own resources were inadequate, and they could not compete with western European nations which had broader stretches of newer and more fertile land. Furthermore, population pressure began forcing these northern Italians to use their land more intensively each generation.

It was the same old story. As the land declined, it had to be used more intensively, which caused still further decline in land productivity. Then the people had to eat less and lower their standard of living in other ways, and soon a subsistence type of farming became the main occupation of most people. Civilization stagnated, and both the productivity of the land and the standard of living of the people continued to decline.

Adria, an example of what happened to the land of the Po Valley, was an Etruscan town built around 550 B.C. on an island a few miles north of the mouth of the Po River. The town became an important city and gave its name to the Adriatic Sea. It was an important seaport and naval station for the Romans during most of the existence of their empire.

By the end of the Western Roman Empire, silt from the highlands had filled in the area so that Adria. was no longer on an island, but was on the mainland. Nothing is known about the history of the city during the Dark Ages, but it was still one of the most important ports on the Adriatic in the twelfth century. By that time, however, Adria was several miles from the sea. Its seafaring citizens had to construct large canals to the Adriatic so ships could still sail into the port of Adria.

The city was waging a brave but losing battle--silt and erosion debris from the foothills of the Alps were gradually making this seaport an inland city. The canals that connected it with the sea were kept open, however, until the fifteenth century, when the city was sacked and burned by its chief rival, Venice. The canals soon filled with silt, and the famous seaport became an inland farm town.

During recent times, Adria has again become a prosperous city with about 30,000 inhabitants, but its prosperity and life now depend mainly on the productivity of the farm land that covers the former sea floor. Adria is fifteen miles from its namesake, the Adriatic sea, and has streets about fifteen feet above the foundations of the houses that the Etruscans built 2,500 years ago.

The Po and other rivers of northern Italy did not select Adria as a focal point for their silt loads, but did much the same to all the coastal cities of the region. The main point is this: the most serious siltation in this region came during the last eight hundred years. The silt loads of the rivers began to accelerate during the Renaissance period, when the area had its most prosperous and glorious period in history. In other words, this region followed the familiar pattern. Its high point in civilization was achieved mainly by intensive use of the land, and this, in turn, brought on the serious erosion that eventually resulted in decline.

We shall not discuss the details of the wars and dissensions and the stagnation of civilization in Italy from the fifteenth to nineteenth centuries. Suffice to say that in 1861 Italy again became united as an independent nation, but this unity did not bring prosperity to the country. Even with the once rich agricultural lands of Sicily and Sardinia, the new Italian nation remained relatively poor. It was an old land with an old civilization, yet it had to depend mainly on the younger civilizations from newer lands to help it try to catch up with modern standards of living. This was not because the Italian people were inferior or decadent, but mainly because they were living on land that had been worn out by their ancestors.

During the twentieth century, the Italians have been trying to restore some of the former productivity to their land. The government adopted, and is now trying to institute, a national policy of sustained-yield forestry. It has also encouraged and promoted other types of conservation, the most fruitful of which has been the draining of some marshes that were created during Roman and medieval times. Around 100,000 acres of excellent farm land have been reclaimed from the famous Pontine Marshes alone, most of which have been drained and are again productive farm land. The malaria-infested marshes around Paestum are being drained and rehabilitated, and other hundreds of thousands of acres are being reclaimed along all coasts of the peninsula. Altogether, the Italian government spent around half a billion dollars on conservation work during the decade of the 1930's.

The twentieth-century conservation work in Italy will undoubtedly help--but it is two thousand years too late to give the Italian people the resources they need to

support a prosperous and dynamic civilization comparable to that of their famous ancestors.

10. WESTERN EUROPE

SOME conservationists contend that Western Europe now has a permanent agriculture on which a permanent civilization might be based, but it remains to be seen whether either is permanent.

The civilization of Western Europe is only about one thousand years old. Most of the agricultural land has been in cultivation less than nine centuries, some of it for only a few generations, and only small, scattered areas have been in continuous cultivation for as long as one thousand years. Most of the civilizations previously discussed lasted longer than one thousand years, and the agriculture in some of them was still virile at the end of the first millenium.

Toynbee sees signs that Western European civilization has already suffered a "breakdown."* *(*Civilization on Trial,* 97-125.) For the last century Western Europe has not fed itself, but depended on heavy imports of food from other continents. The bitter wars of the last forty years were fought mainly because certain nations thought they did not have their share of the land and resources of the world, and since the end of World War II, some nations have not been able to buy the food and raw materials necessary to maintain their previous standard of living.

In other words, there are many indications that Western European civilization is declining and that the decline is due largely to the fact that the population has outgrown the natural resources. At least, the resources in their present state of development and use can no longer support the population at a standard that is conducive to the progress and advancement of civilization.

The crux of the matter seems to be: Will Western Europe be able to adjust its population to its resources? Will it be able to develop, conserve, and use its resources in such a way as to support the present population and any further increases that may come?

It will not be enough for a few of the nations to become self-sufficing. Some of the smaller nations have already attained this goal and seem capable of maintaining their present high standard of living indefinitely, but Western Europe is a geographical and cultural unit. The numerous nations are not united politically and, until 1951, made every possible effort to prevent economic unity. Nonetheless, the eventual destinies of these nations are tied together in this day of rapid communication, transportation, and destructive warfare, when it is impossible for a small segment of Europe to maintain a progressive civilization and high standard of living while the rest of the area declines and regresses.

The question naturally arises just how much of Europe is a geographical and cultural unit that must eventually become a political and economic unit. The answer is not simple. It might well be argued that the entire world of today is a geographical, economic, and cultural unit.

For the purpose of this discussion, arbitrary limits will be established for the region called Western Europe, to include only those nations that have made substantial contributions to Western civilization-Britain, Ireland, France, Germany, Holland, Belgium, Denmark, Norway, Sweden, Switzerland, and parts of Italy, Spain, and Portugal. This may seem like a varied conglomeration of nations and regions, but the history and culture of this region have been inextricably tied together throughout most of medieval and modern times. Furthermore, this region was more or less set apart

from the rest of Europe and the world until the last two or three centuries.

There are encouraging signs that Western Europe, as defined above, has developed a permanent agriculture, that the land can be farmed for another thousand or ten thousand years without deterioration. Scattered fields have been in continuous cultivation since Roman times and are still productive, and, what is more important, a great part of the present farm land has been in cultivation from two to nine centuries.

The climate is conducive to soil conservation over a great part of Western Europe, especially those areas with a marine climate near the Atlantic Ocean and the North Sea. The gentle rains and mists, with the relative absence of torrential downpours, and snow, that protects the clean-tilled fields throughout much of the winter, are important features of the climate. Accelerated erosion proceeds much slower than it would if torrential downpours and bare winter fields were the rule.

Erosion, leaching, and overcropping will, of course, ruin farm land in any region where the land is continually misused, but, because of the favorable climate, farmers of Western Europe have had more time to adapt their farming system to the land and the climate than the farmers of most regions. The land did not erode to the extent that it became unproductive with a few generations of misuse, and the farming practices which increased immediate yields usually helped check erosion and leaching. Manuring, green manuring, crop rotation, and other good farming practices were often adequate to prevent serious soil depletion, and the farmers were seldom forced to fall back on such engineering structures as terraces, water-spreaders, and dams to control runoff and prevent gullying in their fields.

R. V. Whyte and G. V. Jacks have declared that "Europe owes its immunity from erosion to the adaptation of its agriculture to its climate."* *(*Vanishing Lands,* 9.) This adaptation has not been achieved in all places. There are many individual fields and a few large areas that bear serious erosion scars, and there are other lands low in fertility. These depleted soils attest the fact that the land of this region may be ruined by improper farming methods, although it seems likely that the majority of presentday farmers of Western Europe know how to care for their land so that its productivity will continue to increase rather than decline.

On the other band, these European lands were seldom subjected to intensive pressure until the last generation. Throughout the Middle Ages most of Western Europe had a relatively sparse population, and by the time the population became dense enough to put pressure on the land, the continents of America, Africa, and Australia were opened to settlement. These continents have provided some of Europe's food and an outlet for the surplus population for the last three or four centuries.

Also, it should be emphasized that the present farming system of Western Europe was evolved primarily by farmers who owned the land they tilled. Little progress was made toward soil conservation during the Middle Ages, when feudalism and its communal system of agriculture offered little inducement for conservation-and little was practiced. Crop rotation, manuring, liming, and other soil-building methods became common only after feudalism and communal agriculture disappeared.

What will happen to the soils of Western Europe if a communist type of agriculture becomes prevalent? What will happen if the population continues to increase while food imports decrease? Can the farmers of Europe continue their soil-conserving

system of agriculture if these or other potential dilemmas confront them?

A brief look at the history of land use in Western Europe should provide sufficient background information on which to hazard a guess at the probable fate of presentday Europe.

The Phoenicians and Greeks settled most of the coasts of southern France and eastern Spain as early as 500 B.C., but they never moved far inland with their agriculture. Most of Western Europe remained a barbarian country with a primitive agriculture until the first century B.C., when the Romans brought civilization to most of the region now known as France and Belgium. During the next two centuries, the Romans conquered England and southern Scotland and strengthened their rule over most of Western Europe, except Germany and the Scandinavian countries. This rule they continued until the fifth century A.D.

The Romans introduced certain facets of their agriculture to Western Europe, but they never completely Romanized its agriculture because the climate was not suited to the type of farming that prevailed over most of the Mediterranean region. Thus the Romans permitted the Gauls, Britons, and other natives to continue much the same type of farming that they had practiced as barbarians. The main influence of *Pax Romana* was to increase the population and consequently increase the amount of land that was farmed.

In few places did the population become dense enough, however, to put serious pressure on the land. Few areas were farmed intensively, agriculture being confined for the most part to the better lands, and large areas of forest land were never cleared. In addition, the Romans never exported large quantities of grain and other agricultural products, as they did from Sicily, North Africa, and other Mediterranean countries. In other words, little of the land of Western Europe was seriously exploited during Roman times.

It is difficult to get a true perspective on medieval European history because the frequent feuds and wars tend to overshadow the really important events. The tribes and nations of this region fought almost continuously throughout medieval and early modern times, and most of the time they fought for land and the natural resources that go with it.

As soon as the Teutonic tribes had acquired most of the territory of the Western Roman Empire, they started fighting among themselves to see who would get the most. At first the Goths, Franks, and Vandals fought to see who would get what. Occasionally a strong man, such as Charlemagne, brought some semblance of order to a region, but when he died, his heirs fought to see who would inherit the richest part of his empire. In the meantime, the Huns, the Arabs and Moors, and finally the Norsemen assaulted the precarious civilization of Western Europe from all sides. This state of affairs continued for five or six centuries. It is no wonder that the farmers neglected their fields. Property and life were seldom safe for an isolated farmer, since no king or emperor could establish law and order over an extensive area for more than a brief generation, and often a farmer's crops and livestock were not safe for even a single season.

An inventory of the farmers and farm land in Western Europe about nine centuries ago (A.D. 1050) is highly revealing. All the facts are not known, but reasonable estimates can be made from the data available. According to the best estimates, less

than 20 per cent of the land of England was being farmed at the middle of the eleventh century, the remainder being largely forest, swamp, moor, or waste land. Probably one-half of the so-called farm land was in pasture or meadow, so that only about 10 per cent of the total area was being cultivated. Moreover, practically all cultivated land was farmed by the two-field system: one field was planted to grain and the other one fallowed each year. In other words, about 5 per cent or less of the land actually grew cultivated crops each year.

Ireland was more thickly settled than England at this time because it had been spared some of the barbarian invasions, and civilization had never sunk to as low an ebb there, but even in Ireland probably no more than 15 to 20 per cent of the land was under cultivation.

At the same time, only about 12 to 15 per cent of the land of today's Germany, Holland, Belgium, Denmark, and northern France was being cultivated, only 6 to 7 per cent being planted to crops each year. Although parts of southern France and northern Spain were thickly settled, only 20 to 25 per cent of the land was cultivated, 10 to 12 per cent being in crops each year.

Southern Spain and Portugal were relatively thickly settled, but were controlled by the Moors and contributed little to our modern Western civilization, hence they will not be discussed here; and Italy was discussed in the previous chapter.

There are no authentic records on which to base an estimate of the amount of cultivated land in Scotland, Wales, Norway, Sweden, and Switzerland. However, Scotland, Wales, Sweden, and Norway probably had less of their potential farm land in cultivation than did England, and Switzerland was less thickly settled than France and Germany.

Thus most of the land in Western Europe recuperated during the Dark Ages from any abuse it may have suffered during Roman times. Many formerly cultivated fields were reforested or recovered with grass and the fertility largely restored. Much of the coastal plains and valley land became marshy through siltation and lack of drainage, but these lands regained any fertility they had lost through previous cultivation and were highly productive when drained. Indeed, by the middle of the eleventh century, most of the land north and west of the Alps was nearly as productive as it had been before civilization came to the region.

Civilization did not completely die in Western Europe during the Dark Ages, but it almost ceased to exist in many sections. This lack of civilization was not due to lack of opportunity, since civilization was flourishing in the Byzantine Empire, which extended into eastern and southern Italy, and the civilized Arabs and Moors occupied most of Spain and North Africa. The Western Europeans had plenty of opportunity to acquire civilization from these neighboring peoples; but cities are necessary for any high type of civilization, and Western Europe did not have the cities. The farms were not producing enough surplus to support cities.

Most of the cities built during Roman times gradually withered and died during the Dark Ages. At the middle of the eleventh century, there were few cities worthy of the name north and west of the Alps, and those few were located along such rivers as the Rhone, Rhine, Loire, Seine, and Danube, which served as the principal arteries of trade.

Modern Western civilization, which began to emerge during the eleventh century,

was not entirely new, but was an offspring of the ancient Greek and Roman civilizations, and received much of its science from Islam. Yet it is rightfully termed a distinct civilization. And like most other civilizations, it grew on new land--land not exploited intensively by any previous civilization, and land that retained most of its virgin productivity.

Since no king or emperor had been able to guarantee security to the farmers of Western Europe during the Dark Ages, the feudal lords undertook to establish order on a community basis, and by the eleventh century had succeeded in establishing a type of feudalistic law and order over much of the region.

During the eleventh, twelfth, and thirteenth centuries, the amount of cultivated land doubled, tripled, or quadrupled over most sections of Western Europe, which experienced what almost amounted to a recolonization of the region. It was started mainly by the feudal lords and the bishops and abbots of monasteries who wanted to expand their holdings of productive land. Forests were cleared and swamps drained to provide much of the newly cultivated land. As the reclamation program gained momentum, many feudal lords granted special privileges to serfs and others who would clear or drain land and cultivate it, and some serfs were given their freedom and a part of the land they cleared.

This agricultural expansion laid the foundation for the economic revolution that accompanied and followed it. First towns, and then cities, began to take the place of the feudal manors and monasteries that had been the seats of civilization. Population growth was rapid in most areas, and the artisan and merchant class increased in the towns and cities. The growth of towns was especially rapid in the Low Countries (modern Holland and Belgium and near-by areas of France and Germany) because there the greatest amount of land was reclaimed and placed in cultivation.

Feudalism began to break down in almost direct proportion to the increase in the number and size of towns and cities, where most of the artisans and merchants were independent of feudal lords. The larger towns and cities soon found that they could defend themselves and created independent governments; thus city-states began to spring up all over Western Europe, especially in the Low Countries. Many merchants and artisans began to buy land from feudal lords, and others reclaimed wasteland. Some cities took over the land of near-by feudal lords. Such acquisitions added greatly to the number of free farmers and small landowners.

As feudal power declined, more and more serfs were freed, many of them becoming landowning peasants, others becoming tenant farmers or farm laborers. As the kings' powers began to increase in most areas, the present nations of Europe began to take form. In many cases the kings encouraged emancipation of the serfs. Altogether, by the middle of the fourteenth century, a substantial part of the tillable land of Western Europe was being farmed, and in some sections much of it was being farmed by free farmers who owned their own land.

Although historians regard the Crusades as the most important events of medieval Europe during the twelfth and thirteenth centuries--and they did have an important influence on the budding civilization--they were not nearly as important as the landreclamation
and recolonization programs and had much less influence on the future course of history than did the growth of cities and the freeing of the serfs. The

Crusaders, who constituted only a small part of the total population of Western Europe, were largely adventurers and malcontents who preferred to fight to take land away from the distant Moslems rather than put forth the back-breaking work needed to clear and drain better land at home.

For two centuries, almost every generation had its quota of adventurers and discontented people who tried to achieve fame or fortune by going on a crusade. They did not limit their crusades to the Moslems, but conducted some of them against socalled heretical Christians, while petty wars between feudalistic lords continued. But most of the substantial citizens, whether lords, monks, merchants, artisans, farmers, or serfs, stayed at home, where they continued to reclaim farm land, build cities, develop industries, and expand commerce. They were the people who made modern European civilization possible.

Civilization received a temporary setback in Western Europe during the fourteenth century when at least one-fourth of all the people in Europe succumbed to the Black Death. As many as one-half of the people died in some cities, and the population of practically all towns and cities was severely reduced. While commerce and industry declined greatly, agriculture suffered less, but even here the effects were significant. The decrease in population caused by the Black Death caused a decrease in the supply of labor, which meant that less merchandise was produced and traded in the cities and towns. Factories and shops were closed, and ships lay idle.

In the country the effect was somewhat different. True, some of the reclaimed farm land was allowed to revert to brush, forest, or swamp, but most landowners tried to keep their land producing. Many large landowners tried to reestablish serfdom to solve their labor problems, and while they succeeded in some sections, in the main they were unsuccessful. As a result, most of the large landowners, especially in the Low Countries, France, and England, simply used some of their formerly cultivated fields for pasture and became primarily livestock farmers; and many of the medium to small landowners also solved their labor problems by increasing their meadows, pastures, and livestock while decreasing the acreage planted to grain. Thus came about one of the most significant advancements in agriculture of medieval and modern times--the modern system of crop rotation. It also, eventually, led to the present system of European agriculture that some conservationists call stable and permanent.

Modern crop rotation probably originated in the Low Countries during the fourteenth and fifteenth centuries, and by the sixteenth century, most Flemish and Dutch farmers were using a system of crop rotation similar to that practiced by the best farmers of Europe and the United States today. Wheat, turnips, and clover were the standard rotation crops, but there were variations; other small-grain and root crops were substituted for the wheat and turnips, and other legume or grass crops for clover. But they tried to keep the combination of a grain crop, a root crop, and a sod crop growing in regular rotation. This combination, which kept the ground protected from erosion most of the time, furnished grain and roots for human food and grain, roots, and forage for livestock, while the legume and grass crops helped maintain soil structure and fertility.

This system of farming also led to a more extensive use of manure and lime on cultivated fields. From antiquity, many farmers had recognized the value of animal

manure as a fertilizer and the value of ground limestone as a soil amendment, but seldom before had most of the farmers of a large region had sufficient manure to help appreciably, and seldom before had they found it necessary to apply lime to grow a crop. The Flemish and Dutch farmers had a considerable amount of manure because of the number of livestock kept, and they had to apply lime in order to grow clover, since most of their soils were naturally acid and clover demands a neutral or alkaline soil.

The Dutch and Flemish led the rest of Europe in the development of the modern science of farming because they were the first to get rid of the feudalistic, communal type of agriculture. Land reclamation proceeded faster in the Low Countries, cities and towns grew more rapidly, and feudalism disappeared sooner. Furthermore, the church owned less land here than in most other sections of Europe. By the fourteenth century, most of the land was owned either by the farmers who were farming it or by merchants or artisans in near-by towns, who usually let it on long-term leases, often for a lifetime. Communal fields disappeared, except for some of the church lands. Hedges and fences were erected to separate the farms, and even the communal pastures largely disappeared.

These people then began to take a new look at the land they owned or farmed. The farmer-owner and long-lease tenant had a specific piece of land from which to make a living for years to come. Land and livestock became capital assets that would return a profit in proportion to their quality. In other words, agriculture became primarily a capitalistic enterprise; it paid to improve both the land and the livestock, and that is just what these people did. The Flemish and Dutch system of agriculture, which gradually spread to most other areas of Europe, has probably been the most stabilizing influence in modern European history.

Feudalistic agriculture was inefficient in many ways. It had most of the evils of communism, slavery, and farm tenantry with few of the advantages. In addition, it incorporated the two-field system of crop and fallow that had been developed by the Greeks at least two thousand years before. The cultivated land on a manor was divided into two fields, and each field was divided into small, narrow strips of about one acre each. One field was planted to grain each year while the other lay fallow. Each serf was assigned a few strips of ground to farm, but he seldom got the same strips for two years in succession and consequently had little interest in improving the land. The pastures and meadows were entirely communal and were usually overgrazed. Manure was seldom applied to the land, except as the livestock dropped it in the course of their grazing. Lime and wood ashes were used as fertilizers on only a few manors, and soil erosion generally went unnoticed and unchecked.

The climate of Western Europe was such that the land survived this abuse and responded to good care, which did not come, however, until the owners of the land started farming it themselves. Good farming practices spread over other sections of Europe in almost direct proportion to the breakdown of feudalism and the rise of owner-operators.

There was another factor that had an important influence in the development of modern European agriculture: the use of horses as draft animals. Strange as it may seem, none of the farmers of antiquity, including the Greeks and Romans, ever learned to harness the horse for use as a draft animal. They did virtually all their

plowing and heavy hauling with slow oxen. A horse can pull a heavier load than an ox, and a moderate load about twice as fast, but he must be properly harnessed in order to do this. All the ancient harness was so constructed that it choked the horse as soon as he lowered his head and tried to put all his power into pulling a load. Sometime during the Dark Ages, probably in the eighth or ninth centuries, a European farmer invented the horse collar and traces. (The modern breast harness came later.) Not only did this simple invention start European farmers to using horses as draft animals, but it enabled them to hitch four or more horses abreast and to drive eight or more horses as a team. Until this time, one or two yoke of oxen was about all the power that one man could handle. Also, European farmers began to breed bigger and better draft horses as soon as they learned how to use them. In other words, the invention of the horse collar and traces literally revolutionized the power situation on European farms.

With the increased horsepower, larger plows, such as the wheeled plow, which required four to twelve horses to pull it, followed. Altogether, these improvements in farm power and machinery meant almost as much to European farmers of the late Middle Ages as the tractor has meant to twentieth-century American farmers. European farmers began not only to produce more per acre, but also to farm more acres per man. They were able to increase greatly the amount of food that one farmer could raise, which meant that more men were freed to pursue the arts and crafts. All this set the stage for the phenomenal advances of modern times.

The Renaissance, the Reformation, Columbus' discovery of America, Da Gama's and Magellan's voyages, and the numerous wars make most of the headlines of European history from the fourteenth to eighteenth centuries, but none of these events had as great an effect on the ultimate fate of Europe as the progress of agriculture during that time.

Although the Renaissance developed in northern Italy from the eleventh to the fourteenth centuries, the focal point did not remain there long, but shifted to the Low Countries, England, France, and Germany, where there was enough good, fertile land to support the many cities needed for this modern civilization. Furthermore, with the invention of the sailing ship and compass, travel on the Atlantic became feasible, and when the New World was discovered, the people of Western Europe no longer had to depend on overland commerce through the cities of northern Italy.

The Reformation of the fifteenth and sixteenth centuries, a natural sequel to the Renaissance, was more than a religious reform--it was a land reform, too. Land reform was perhaps both one of the fundamental causes and one of the chief results of the Reformation.

According to Boissonade, the Catholic church owned or controlled one-fifth or more of all land in most sections, and as much as four-fifths in some areas of Western Europe during the fifteenth century.* (*Prosper Boissonade, *Life and Work in Medieval Europe,* 319.) Some of the church land had been cleared or drained by monks during the Middle Ages, but the greater part had been bequeathed to the church, which was rapidly acquiring more and more land and seldom relinquishing any. Moreover, many bishops and abbots were still trying to farm the church lands with a modified form of feudalistic agriculture.

Various kings and lords had long wanted the church land, but they were seldom

strong enough to take it while the people supported the church. When large numbers of land-hungry peasants turned against the church, however, many kings and nobles were willing to risk excommunication to gain their end. All these various factors helped bring on the Reformation and religious wars, during which the kings, nobles, and rich merchants seized immediate control of most of the church land and, at least, put it back into circulation. In a few areas, peasants, artisans, and small merchants obtained control of much church land; and in most countries the peasants received not only religious freedom from the Reformation, but also a great deal of political freedom that eventually resulted in their getting most of the land.

Columbus discovered America in 1492, Da Gama sailed around Africa in 1497, and by 1521 Magellan's crew had circumnavigated the globe. These were dramatic events, then as now, but they were dramatic to only a handful of people outside of Spain and Portugal. News of them hardly made a ripple among the great mass of Europeans. Dutch farmers were busy building dikes to keep the salt water of the North Sea off their land and trying to find better ways to raise wheat, turnips, clover, and dairy cattle. English farmers, more interested in their sheep than in the Americas, were busy clearing and draining the land of their own country, which was not yet well settled. German peasants were little interested in land across the Atlantic Ocean; they wanted to own a few acres of the church land they were farming or to get better working conditions from the feudalistic lords. In France, where communal pastures were still the rule, the main concern of many farmers was whether their neighbor's livestock would eat their crops before the harvest. The Danes and Norwegians had heard of America long before, but in 1500 most of them were more concerned with the burdens their feudalistic lords were imposing on them than in sailing across the Atlantic as their forefathers had done.

The craftsmen and laborers in the cities heard more about the Americas than the farmers, but few of them gave any thought to going there. They were too busy making a living at home. The rich merchants and shipowners probably considered the possibilities of trade with the American Indians, but were much more interested in the new trade routes to India and China. In fact, about the only people who became immediately interested in the Americas were the Spanish and Portuguese adventurers who sought gold and silver.

The Spaniards and Portuguese were the first to colonize the Americas. This was natural. Spain and Portugal were more thickly settled than most other sections of Western Europe and had a more advanced civilization than any of the other nations facing the Atlantic Ocean, for they had been in close contact with the Islamic civilization of the Moors. Of greater significance, however, is the fact that they were living in an older land--a land that had endured the exploitation of civilized man's agriculture longer than the neighboring land.

Much of the land of eastern Spain was seriously exhausted during Roman times. Since the Arabs and Moors brought their dry-land farming and irrigation agriculture to the peninsula less than three centuries after the fall of Rome, the land did not have a long period for recuperation as did most of that of Western Europe. The Moors cultivated it intensively from the eighth to the thirteenth centuries, so that by the fifteenth century much of it was severely eroded and exhausted. Thus the possibilities of new land across the ocean began to appeal to these people sooner than it did to

Europeans who still had plenty of fertile acres at home.

The Spaniards began to colonize parts of America within a generation or two after its discovery. The wealth acquired from these colonies made Spain the strongest power in Western Europe for nearly a century, but, like most other colonizers of distant lands, Spain had to retain control of the seas to exploit her colonies. When Britain wrested control of the Atlantic from her at the end of the sixteenth century, Spain rapidly declined. She struggled to regain her former wealth and glory, however, until early in the nineteenth century, when the Latin American colonies rebelled and became independent. After that the Spanish people were again forced to live from their home resources--the eroded, exhausted land which was incapable of supporting a prosperous civilization. The rise and decline of Portugal came at about the same time as that of Spain, and for much the same reasons.

It was more than a century after Columbus' discovery before the people of Northwest Europe gave much thought to settling the new land in the Americas, and then it was only a few of the more venturesome who were trying to escape religious or political persecution at home. Still another century elapsed before appreciable numbers began to sail to North America to seek a home, and for another century and a half after that, the settlers came in relatively small numbers. The real land rush to America from northwestern Europe did not get fully underway until the last half of the nineteenth century.

For example, in 1690 the total population of the English colonies in North America was about 250,000, and in 1760 the population was approximately 1,600,000. Since a substantial part of this increase can be credited to descendants of the original colonists, it seems safe to estimate that not more than 150,000 emigrants from Europe had settled in the area now incorporated in the United States before 1690, and not more than 500,000 during the seventy years from 1690 to 1760. Most of them were English, but there were some Dutch, German, Swedish, and other nationalities.

Emigration to the United States during the last half of the nineteenth century provides a striking contrast. During the 1850's more than 200,000 emigrants from northwestern Europe went to the United States each year. Altogether, at least twelve million northwestern Europeans emigrated to the United States between 1850 and 1890. These later emigrants were preponderantly German, Irish, and Scandinavian; nevertheless, it seems safe to say that there were more English emigrants to the United States during the last half of the nineteenth century than during the previous three and one-half centuries, and many other Englishmen emigrated to Canada, Australia, New Zealand, South Africa, and other British dominions.

Few people of Northwest Europe migrated to the newly discovered continents during the sixteenth, seventeenth, and eighteenth centuries mainly because there was still enough fertile land to support them at home. The large migration in the nineteenth century began for much the same reason that all other mass migrations have taken place: the population of the region began to outgrow the resources. Whether they went as emigrants to the new nations in the Americas or as colonists to Africa, Australia, or other regions, their reasons for leaving Europe were much the same. They were seeking new land and the wealth that may be acquired where plenty of good land is available.

Agriculture in England developed along much the same lines as in the Low

Countries but at a slower pace. While most of the tillable land was cleared or drained by the middle of the eighteenth century and modern crop rotation was introduced from Holland early in the seventeenth century, it was not a general practice until the last of the eighteenth century. Although the enclosure of fields and farms with hedges began during the sixteenth century, communal pastures were common until the eighteenth century. During the eighteenth century, remarkable progress was made in breeding livestock, and a majority of the breeds of cattle and sheep now raised by American farmers were developed in England during the eighteenth and nineteenth centuries. Improved varieties of crops were introduced or developed, manuring and liming became more extensive, and soil fertility was greatly improved during the eighteenth and nineteenth centuries. By these and other means, the English greatly increased their food production.

The so-called Industrial Revolution in England at the end of the eighteenth century was activated by many technical improvements, such as the use of coke instead of charcoal for smelting metals and the development of the steam engine, but these and all the other labor-saving devices in the factories would not have made this revolution the phenomenal success it was except for the fact that food was plentiful.

Modern European agriculture made it possible for a farmer to produce much more than any farmer had ever produced before. For the first time in the history of mankind it became possible for the urban population of a region to exceed the rural population, because for the first time one farmer could produce more than enough to feed his own family and another family in the city.

In addition to the increased farm production at home, England was also receiving substantial imports of food and raw materials from abroad by the nineteenth century. The population of cities and towns grew by leaps and bounds, and the total population increased rapidly.

As the improved industrial techniques made it possible for each worker to increase his production, England was soon producing more factory goods than her people could use. She exported the surplus in exchange for food and raw materials, which meant still more people and more manufactured goods. The spiral continued until the twentieth century, while Britain became mistress of the seas and the international banker and trader of the world.

Modern agriculture developed more slowly in France than in England. This was not because the French were slower in clearing their land, for land reclamation proceeded faster over most of France than it did in England, but because the people of France did not gain political and economic independence as rapidly as in Holland and England. As feudalism disappeared, it was replaced by absolute monarchy. Up to the time of the French Revolution, 1791-93, the king and his favored lords subjected most of the peasants to political and economic dependence that approached serfdom. The greatest progress in French agriculture came during the nineteenth century, when French farmers instituted most of the reforms in their methods of farming.

Communal pastures continued to be the rule in France until the last half of the eighteenth century, and manure was not used in large quantities on cropland until after communal pastures disappeared. Modern crop rotation was not generally practiced except in some northern provinces until the nineteenth century, and stock breeding made little progress until after crop rotation that included clover and grass became

common. And, as has been previously pointed out, that part of southwestern France with a Mediterranean climate has been cultivated off and on for 2,500 years, so that the land was severely eroded and had lost much of its fertility long before modern times.

From the beginning of the nineteenth century, French agriculture progressed rapidly, and by the end of that century, nearly all sections of northern and western France, favored by a marine climate, had a stable agriculture. Agricultural production is now two or three times as much as it was in 1800.

In parts of the Rhineland and northwestern Germany, agriculture advanced as fast as in the Low Countries and northern France, but in what is now central and eastern Germany, agricultural advancement was much slower. Feudalism came to Germany later than to France, the Low Countries, and England.

The emperors of the Holy Roman Empire held off complete feudalistic control of Germany until the thirteenth century. About the time that the farmers of the Low Countries were shaking off the yoke of serfdom, the peasants of central and eastern Germany were succumbing to a type of serfdom bordering on slavery. Most of Germany remained feudalistic, with a feudalistic agriculture, even after the Reformation of the sixteenth century, and feudalism did not disappear until the Prussian kings came to power about the middle of the seventeenth century. Even then the main body of German peasants gained little political freedom, although their economic condition has improved greatly during the last three centuries.

After the Prussians gained control of most of Germany, certain farsighted rulers began a planned program of agricultural development as a matter of statesmanship. Frederick the Great, 1712-86, one of the foremost rulers in this respect, directed a large land-reclamation program. Some 400,000 acres of forest and swamp were cleared and drained under government supervision during his reign, and peasants were imported from Poland and other areas to help reclaim and farm the land. Frederick eliminated communal pastures, encouraged livestock breeding, and introduced new crops. Most farmers were relieved of some tax burdens and other restrictions. Apparently Frederick realized that Germany could become a prosperous nation only if she had a prosperous agriculture.

For a century and a half after Frederick the Great, German agriculture developed slowly but surely. Crop rotations and other soil-building practices similar to those of the Dutch and English came into general use, and the German farmers improved on a number of good farming practices learned from their neighbors. Since much of their farm land was not level, as in the Low Countries, some German farmers made their rows level by contour farming, and others made their fields level, from end to end, by contour strip-cropping. The Germans probably deserve most of the credit for starting sustained-yield forestry, and they were among the leaders in developing the use of commercial fertilizers. They did not discover the potato, but they used it to a greater extent than any other nation except Ireland. Their adoption of this crop gave them more food per acre, because of the high yields of potatoes in comparison with most other food crops. Altogether, by the beginning of the twentieth century, Germany was among the world leaders in practicing scientific agriculture.

The Germans did not migrate in large numbers to other continents until the middle of the nineteenth century when their own lands became fully occupied. By the time

they became too crowded for comfort, about 1850, most of the desirable lands in the Americas, Africa, and Australia had already been taken by other nations, and they had to resort to emigration to the United States and other new nations instead of colonizing barbarian lands.

Agriculture over most of Germany was considered stable until the last decade, and it still seems stable in the northern and central areas where a marine climate prevails. The productivity of most of the farm land had been improving for the last century, most forested areas were yielding more timber than ever before without depleting the forests, and livestock production was on a sound basis. During World Wars I and II, German farmers demonstrated that they could produce a subsistence ration for the entire nation, but in doing so, they apparently started deterioration of some of the land. Many German conservationists have expressed deep concern about accelerated erosion, especially in southern areas, since World War II.

Feudalism did not break down in Denmark until the eighteenth century. Modern agriculture came to that country only during the last half of that century, and new land was still being cleared or drained in the nineteenth century. Apparently Denmark has been fully settled for less than one hundred years, because population pressure did not induce extensive emigration until around 1880.

At present, Denmark is one of the most advanced agricultural countries of Europe. Its population density is about 225 persons per square mile, and approximately onehalf of the people live on farms. Danish farmers produce enough food for the entire population, with a surplus for export. They export mainly butter, cheese, bacon, and eggs, and import concentrated livestock feed, commercial fertilizers, and manufactured goods.

Originally, the soil of Denmark was not especially fertile, most of it being too sandy to be highly productive. Over the last century, however, the Danes improved the productivity of their land until it now produces two or three times what it did when first placed in cultivation. Most farmers use a crop rotation which keeps a great part of the land in grass or clover, and apply manure liberally and use lime and commercial fertilizers on cropland.

Apparently the Danes have found a satisfactory substitute for the "Nile." It consists of crop rotation, grass, legumes, manure, and mineral fertilizers. Denmark, if isolated from the rest of Europe, could probably be said to have a permanent agriculture--a system of farming that could endure for thousands of years without damage to the land. A permanent civilization could be built on such an agriculture, not only in Denmark but over most of the world.

Essentially because of climate, topography, and location, Norway, Sweden, and Switzerland were backward countries throughout medieval and early modern times. Their agriculture developed slowly, but on a sound basis.

Norway has a stable agriculture in spite of steep slopes. Only about 4 per cent of the land is now cultivated, and it is kept in grass or legume crops a great part of the time. The remainder is largely forests, which for the most part the government controls under a rigid conservation program.

Switzerland has a problem similar to that of Norway, but has a greater proportion of tillable land. Only small areas are planted to clean-tilled crops, however, and a major part of the tillable land is kept in meadow or pasture. Swiss farmers raise most of the

food consumed by the Swiss people, but the country imports some grain for human consumption and livestock feed. The Swiss depend primarily on tourist trade and industrial exports for money to buy imported food, but during the world wars, they demonstrated that they can produce enough food at home, at least for a limited length of time.

Swedish agriculture, which might be described as a combination of Danish and Norwegian farming and forestry, is apparently stable, and the Swedes might maintain themselves indefinitely from their own land. Many Swedes emigrated to America during the last two decades of the nineteenth century, but such emigration has largely ceased. At present it seems unlikely that the Swedish population will outgrow the land resources soon.

Ireland is a prime example of the fact that continued abuse will ruin land, even where a mild marine climate prevails. Ireland, about twice the size but with approximately the same population and climate as Denmark, probably had much better soil than Denmark originally, though it does not have better soil today. Erosion has destroyed the productivity of much of the sloping land, while siltation has damaged most of the lowland. Ireland has only about one-half as many people as a century ago, most of them relatively poor.

Some Irishmen are inclined to blame all of Ireland's troubles on the oppression of the English, which doubtless has contributed, especially to the extent that the English helped exploit and ruin Ireland's land. But the fundamental reason why the Irish are fewer and poorer is that the productivity of much of their land is gone. It is the same old story told about Crete, Lebanon, Greece, North Africa, and other areas.

A part of Ireland's troubles stem from the fact that the land did not enjoy a recuperative rest during the Middle Ages. Ireland was spared the full fury of the barbaric invasions, and thus civilization did not sink as low as it did over most of western Europe. Civilized farmers continued to exploit a substantial part of the land while most English, French, and German land was resting. But that is not the main trouble. Most of the land damage has occurred during the last two centuries. Potatoes, grown for both home consumption and export, did to Ireland what deforestation and goats did to Lebanon and what cotton did to areas in the southeastern United States. The Irish, who were slow in achieving a stable type of agriculture, did not generally adopt crop rotation, manuring, liming, and other soil-improving practices until the twentieth century.

Although Irish agriculture has been largely reformed during the last few decades, the reform came too late to save some of the formerly productive land. Still, Ireland should be able to improve her situation. Much of the land can be restored to productivity, but it will take time--maybe several generations. In the meantime, the Irish people must pay for the sins of their forefathers.

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Before returning to the discussion of twentieth-century Europe's agricultural problems, we should examine some of the more spectacular accomplishments of Europeans in conserving their land. Soil conservation has not been entirely a matter of crop rotation, manure, lime, grass, legumes, and commercial fertilizers. Over most of England, Denmark, and Belgium little was needed except these good farming practices; and parts of Holland, France, Scotland, Germany, and Sweden were

likewise favored by the climate and terrain. But in other areas more heroic measures were necessary, and in many cases these Western Europeans used such measures rather than see the basis for their food supply and civilization slip away.

Many Dutch farmers went to great lengths to reclaim and protect their land. As has been mentioned, the Dutch, who, developed a deep sense of conservation early, were among the first to use modern crop rotation and other soil-improving practices. Possibly it was because they realized they were not numerous enough to take the land of their neighbors if they wore out their own that they became conservationists, and it was probably because of their early battles with the North Sea that they got the idea of taking land away from this sea.

They started by building dikes to keep the sea from encroaching on their land. Then, by the nineteenth century, they took the offensive and started reclaiming land from the ocean floor by diking off the sea, dewatering the land, leaching it of its salt, and converting it into productive farm land. Today some 45 per cent of their land is below high-tide level, and 25 per cent of it is below mean sea level. They put forth tremendous efforts to reclaim some of this land from the sea. "Reclaiming" is the proper term, because this land was once soil on the hills and mountains of Germany, Switzerland, and France that was given to the sea by the Rhine and Meuse rivers and taken back by the land-hungry and conservation-minded Dutch.

The French have also encountered serious conservation problems. Southeastern France has rock-wall bench terraces which farmers are still using for vineyards and orchards; these terraces, built at least one thousand and possibly more than two thousand years ago, are similar to those found in Lebanon. Native inhabitants perhaps got the idea for such terraces from the ancient Phoenicians.

Floods have been a major problem in the foothills of the Alps since medieval times, at least. Deforestation and overgrazing of the hills and mountains led to torrential outflows of water, soil, gravel, and rocks on valley lands. The problem was acute by the fifteenth century, yet little was done to solve it until about 1800, when a series of torrents drowned so many livestock, piled so much rocky debris on fields, and destroyed so much property that the French government took a hand. Reforestation of the hills was attempted, but the livestock herders fought it in every way. Floods continued for another fifty years, until 1856, when a terrific storm caused so much damage that the government was forced to take positive action. Reforestation was instituted over all objections, but the problem was not entirely solved until pasture improvements, check dams, levees, storage basins, and other works slowly brought the torrents under control. This work, started by the government in 1882, continues today and has recently been inaugurated in areas near the Pyrenees, which have similar though less acute problems.

The French also have done spectacular work in controlling sand dunes. The most notable effort was their fight to control the large area of dunes along the shore of the Bay of Biscay in southwestern France, known as the Landes de Bordeaux, an area of nearly three million acres, originally in pine forest. The French say that the Vandals burned most of this forest during the fifth century. With the trees gone, prevailing winds, sweeping in from the ocean, started the beach sands piling Up into dunes, which, rolling eastward, eventually covered 400,000 acres. The trees surviving the fire died, streams were choked, and more than two million acres of marshes were

formed. Once a source of resin and timber, the area became a malarial pesthole, routing the populace more effectively than any invading army.

Napoleon, perhaps fearing the use of this deserted shore line as an invasion point, set his engineers to work building a picket fence on top of the dunes near the shore line. The fence partially broke the force of the wind and caused it to drop the sand it was carrying. As the fence was covered with drifting sand, the pickets were pulled up and reset on top of the dune, and eventually a large windbreak dune was formed all along the coast line. Behind this barrier the land was reforested and the swamps drained, and the Landes forest again became an asset instead of a liability to France.

Less spectacular, but just as significant, have been the individual conservation efforts of French farmers. The wealth, character and industry of a twentieth-century French farmer is judged partly by the size of the manure pile in his yard. Crop rotation, with plenty of grass and legumes, is an almost universal practice, and strip crops and contour tillage are common on sloping fields. Another gauge of a French peasant's love for his land is his practice of hauling or carrying soil from the bottom of a sloping field to the top. Each winter some farmers dig up the bottom furrow of a field, load the dirt into carts, and haul it to the upper edge, where they distribute it along the top furrow. Where the slope is too steep to haul the dirt up hill, some actually carry it up in bushel baskets. This practice, which helps compensate for the downhill movement of soil by sheet erosion, is effective only where erosion is slow, but a farmer who is going to haul or carry the eroded soil back up the hill will see to it that such erosion is slow.

Switzerland has flood-control problems similar to those of southern France, and the Swiss have solved their problems in much the same way as the French. Their strict laws about the cutting of trees are due not only to the flood menace but also to the danger of snow avalanches. They have built phenomenal masonry structures, such as check dams, and they have built stone-wall bench terraces on some of their cultivated fields.

The Scottish highlanders have had serious land problems. Erosion became acute on much of their land during the latter part of the eighteenth century, but they checked it by putting the steepest slopes back to grass, practicing crop rotation, contour farming, and strip cropping on other sloping fields, and using a system of terracing similar to that employed by American farmers today.

We might cite other examples of spectacular or heroic efforts toward soil conservation on the part of individual farmers or groups, but such examples would not alter the broad picture presented. In general, Western Europeans have been conservationists, up to now, partly as a result of their favorable climate, but partly also as a result of individual and collective efforts of farmers and governments.

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Although Western European civilization inherited much of its science, art, and other civilizing influences from previous civilizations, it is rightfully classed as a distinct civilization by most historians, and it should be classed as one of the outstanding civilizations of mankind, especially so far as material advancement is concerned.

For four or five centuries Western Europe was the principal center of civilization for the entire world. It spread its civilization to every continent and to almost every community on the earth. With the aid of its offshoot, the American civilization, it has

given mankind greater material advancement than all the civilizations that preceded it through six thousand years of recorded history, and it has provided more labor-saving machines, more leisure time, and more food for its citizens than all preceding civilizations.

It should be emphasized that this Western European civilization was built on fertile soil, a marine climate, crop rotation, horsepower, manure, and capitalism. Coal and steam gave it a decided boost during the eighteenth and nineteenth centuries, but the primary basis for this civilization, then and now, is the land of Europe and the food and other necessities that it produces.

For the past century, Western Europe has depended partly on colonization and exploitation of other lands and peoples to prolong its supremacy, but this is only a temporary expedient, as it was for many previous civilizations. Time is now catching up with Europe. In the twentieth century this region is being forced back on its own resources. Possibly electric power, atomic energy, or the harnessing of sunlight may give it another extended lease on life, but this is not likely unless Europe finds a way to feed itself from its own land.

Modern Europe had its first general food crisis during World War I. For four years, Germany, Denmark, Sweden, and Switzerland had to depend almost entirely on the food raised in their own countries. Food imports to Norway, Britain, Holland, Belgium, France, and Italy were greatly decreased, and considerable areas of farm land were taken out of production by invading armies, especially in Belgium and France. A few areas, such as Denmark and Sweden, continued to eat well because they produced ample food at home, but most Europeans went on short rations, and some of them actually starved.

This war brought home to most Europeans, in a forceful way, the fact of their woeful dependence on other continents for food and raw materials, and it also indicated that imports could be rudely and suddenly interrupted. Of course, most importers and some statesmen already realized these facts, but after World War I, the general run of people, who had thought that if cities and industries continued to grow and make money the food supply could always be bought and distributed, began to realize the truth. Furthermore, at the end of the war, many European nations found themselves too poor to buy abroad all of the food and raw materials they had been purchasing before the war.

Reactions in the various European countries were different, but nearly all nations began to lay plans to prevent a recurrence of such a famine. The British naively concentrated on the perfection of submarine detectors and destroyers, passed laws about tariffs and subsidies, and used other artificial stimulants to encourage a favorable trade balance for the people on the "tight little island." They exhorted their dominions and colonies to produce more food and raw materials for export to England, apparently failing to sense the lessons of history taught by the experiences of the Minoans, Phoenicians, Greeks, and others.

The French and Belgians built their Maginot Line and looked wishfully at British progress in antisubmarine warfare. They also created artificial trade barriers, exhorted their colonies to produce more, and naively assumed that the *status quo* would remain the *status quo.* The defeated but more efficient Germans gave serious thought and effort to increasing agricultural production at home, but at the same time, they looked

longingly at the Russian Ukraine and laid plans accordingly. Others reacted in still different ways.

Then World War II put all these plans to a crucial test. The results ranged from poor to disastrous. We need not go into the details of the ride of the "Four Horsemen" across Europe from 1939 to 1945. The British found that their antisubmarine devices had been improved no faster than the German submarines, the Maginot Line failed to hold, the Germans captured the Ukraine but failed to hold it long enough to grow much food there, and this time the Dutch, Danes, and Norwegians were not spared. Farmers continued to eat well, except where the German army discovered and confiscated their hoarded food, but few of the city people escaped the pangs of hunger. Malnutrition was most acute among the aged and the children, while tuberculosis and other nutritional diseases became rampant. It seems safe to say that "the rider of the black horse," famine, caused more human suffering than did "the rider of the red horse," slaughter. Actual starvation and pestilence, the result mainly of malnutrition, probably caused more deaths and deformities than all the bombs and bullets of the war.

Now the Europeans are making their plans all over again. Will they learn from the lessons of the past? Will they recognize that prosperity and freedom can be bought only with natural resources and human ingenuity in conserving and using those resources? Or will they try again to circumvent the inexorable laws of nature?

It is too soon after World War II to assess all the damage and determine where Western Europe now stands. The scars of war are too fresh to discern the difference between temporary war damage and permanent economic failure, but a few significant developments may be observed which indicate that Europeans are becoming more and more food conscious, although they are not yet fully reconciled to the necessity of living off their own land. Many nations still hope to find a way whereby they can continue to export their trade and industrial skills and receive food and raw materials in return. Some of them may be able to carry on in this fashion for a few more decades, but not forever. The remainder of the world is rapidly becoming industrialized, and eventually, as industrialization increases on the other continents, Europe will find that these continents are no longer willing to exchange unlimited amounts of food and raw materials for industrial products.

ABOVE: *Contour strips, in Germany, make the fields level from end to end. The contour strips of hay, grain, and clean tilled crops shown here are part of the answer of German farmers to the menace of soil erosion and declining fertility.*

(Photograph by the Soil Conservation Service)

BELOW: *The Dutch are careful about using their land wisely. This pasture is on almost level land that the people of Holland reclaimed from the sea at a cost of more than $200 an acre. The grass crop is part of a regular rotation plan that helps maintain the structure and fertility of the soil.*

(Photograph by Walter C. Lowdermilk, Soil Conservation Service)

Erosion has ruined much land in Latin America.

ABOVE: *From three to six feet of soil has been stripped from this once productive field in Mexico.*

BELOW: *A formerly cultivated hillside in Guatemala that has been all but ruined by erosion.*

(Photographs by Soil Conservation Service)

It should be possible for Western Europe to produce all the food its people consume and most of the raw materials required for its industries. The region, as a whole, has a population of about 225 persons per square mile--a little less than three acres per person. About one-half of the land is unsuited for food production, and thus there is less than one and five-tenths acres of arable land per person. Actually, only about one acre per person is being farmed at present, but the other half-acre is there if developed and properly used. This acreage should be adequate if farmed according to the bestknown methods. Western Europeans could produce enough food for themselves without damage to the land, and with improving technology, they could doubtless produce enough for a moderately growing population.

Some of the more densely settled countries, such as England, Belgium, and Holland,

that have a population of more than five hundred persons per square mile, may find it difficult to produce enough food for their people--that is, unless they are willing to accept a vegetarian diet. And there are parts of Spain and other countries with less dense populations but with more extensive land damage that may find it extremely difficult to provide an adequate diet for all the people. These overpopulated and landdepleted
countries have the most urgent problems, but the problem of obtaining adequate food and raw materials is rapidly becoming urgent for nearly all countries.

The possible solutions to Western Europe's problems are not numerous; there are not a great number of alternatives. Any effective and permanent solution must be based on the adjustment of population and the standard of living to usable resources. This may be done by (1) conserving, developing, and using existing resources more efficiently; (2) restricting the population through dispersal of the people to other continents, birth control, or other means; or (3) adopting a standard of living based essentially on a vegetarian diet and industry that does not consume large amounts of raw materials.

The conservation, development, and use of existing resources could undoubtedly be handled more efficiently if Western Europe were united into a political and economic entity. It is doubtful if some of the present nations can solve their problems of survival and maintain their present standard of civilization without such unity, but a United States of Europe would not necessarily solve the problems. The hard facts remain that adequate natural resources must still be available and must be developed, conserved, and used efficiently. A united attack would merely promote efficiency in the use of available resources. Each area might thus freely exchange its surplus of one thing for something it lacked, and the region, as a whole, might mass produce industrial products more efficiently. But the conservation of existing resources must be practiced diligently--generation after generation--if this solution is chosen.

Restriction of the population through dispersal or birth control might be fairly simple for some nations, but for others it would be very difficult. For example, the English might easily migrate to Canada, Australia, or other English-speaking dominions of the Commonwealth, but the Italians, on the other hand, have few places to which they can migrate, and their religion formally forbids birth control. It should be emphasized that the restriction of population would probably be only a temporary remedy at best, for it must be accompanied by effective conservation of the natural resources if the restricted population is to retain its standard of living and continue its progressive contributions to world civilization.

Few, if any, of the peoples of Western Europe will adopt a lower standard of living until they are forced to do so, and they will do so only if they fail to attain a balance between people and resources. Nevertheless, a lower standard of living must become the solution unless the present and succeeding generations take positive and vigorous action to either conserve and develop the natural resources or restrict the population.

The overcrowded sections of Western Europe have been fully populated for only three or four generations. During most of this time, Europeans have depended partly on other lands and peoples, mainly colonies and more backward countries, for much of their food and raw materials, but the present generation is finding that the other lands and peoples are no longer willing to be exploited. This may seem like a new

phenomenon to some Europeans, but it is not; it is a pattern of history. Western Europe has just arrived at the same dilemma that confronted the Phoenicians, Greeks, and other great colonizers thousands of years ago.

Many people of Western Europe have put forth valiant efforts towards conserving their natural resources. They probably have been more conservation-minded than any of the other peoples discussed, except the Phoenicians, but their crucial test is yet to come. Apparently it is coming soon--when Western Europe must support a dense population primarily from its own resources.

Many pitfalls lie ahead. A communistic type of agriculture might rob these conservation-minded farmers of the incentive to conserve and improve their land; population pressure might become too great to permit a wise husbandry and conservation program; and continued warfare might make it impossible for most farmers to keep practicing their customary type of agriculture. Other nations and civilizations of the past have doubtless thought they were permanent, only to have their hopes wrecked within a few generations.

It is not feasible to attempt a positive answer to the question posed in the first part of this chapter: Has Western Europe built a permanent civilization, based on a permanent agriculture? All answers are conditional, depending primarily on that great variable, human conduct. It is plausible to say, however, that Western Europe has the potential resources and the technology necessary to develop a permanent civilization. The outcome depends largely on the actions of the people, especially on the actions of the present and the next few succeeding generations.

11. HERE AND THERE--
PAST AND PRESENT

S0 FAR this discussion has been largely confined to those areas that contributed most to modern American civilization and has not dealt with the peoples and civilizations over most of the land mass of Asia, Central and South America, Central and South Africa, Australia, and Oceania. Up to the twentieth century, these regions played minor roles in the development of American civilization. But, because in this age of rapid communication and transportation, these countries are becoming of increasing importance to the people of the United States, a few of the more significant areas should be discussed briefly. In most of the regions the pattern of rise and decline of civilization varies but slightly from that of the areas already examined.

In the Indus Valley, in what is now Pakistan, arose one of man's earliest civilizations, which archaeologists class as contemporary with the early Sumerian and Egyptian civilizations. The history of the Indus Valley, like the setting, is similar to that of Mesopotamia. The early civilization was based on irrigation agriculture, and used the water supplied by the perennial flow and the semiannual floods of the Indus River. Cities, some of which lasted for more than fifteen centuries, were built of burnt brick and were located along the shores of the lower Indus and on some of its tributaries.

As the foothills of the Hindu Kush and Himalaya Mountains were deforested, floods and siltation increased, so that silt in the irrigation waters and canals must have become a terrific problem. Archaeological findings show that some of the ancient cities were temporarily abandoned on account of floods at least twice before their final downfall.

Little is known of the downfall of this early Indus civilization, but its extinction came about 1700 B.C., apparently as a result of conquest by the barbarous Aryans who sacked the weakened cities and brought on a "dark age." A new civilization arose in the Indus Valley a few centuries later, although it probably never attained the density of population of the earlier one. Through all the vagaries of wars and conquests, civilization continued to survive in the valley until approximately A.D. 1200.

In the meantime, the Indus River was becoming increasingly hard to control. The silt of the river built its bed and alluvial plains higher and higher, floods became more frequent and drastic, and the course of the river shifted constantly. Finally the inhabitants gave up the fight to control the river and use its water to irrigate the arid plains. The ancient history of the region became veiled in obscurity, and modern historians and archaeologists did not suspect the existence of the earliest Indus civilization until around 1922, when they began unearthing the ruins of some of the ancient cities.

Today most of the lower Indus Valley is relatively barren country, and even in a region as thickly populated as southern Asia, few people have lived on the sun-baked mud flats and shifting sand dunes in modern times. Some of the foundations of the ancient cities are now below the ground-water level, and the river, whose channel is at least twenty feet higher than it was three thousand years ago, overflows during every

flood and covers the near-by alluvial plains, which are lower than the river bed. The climate is apparently the same as in ancient times, but the land is not.

Efforts are being made to reclaim this area, irrigate it, and restore it to something like its former productivity. This should be possible because there is still plenty of soil in the valley, even though it is erosion debris from the highlands. The problem of restoring this area should be much the same as that for Mesopotamia, but reclamation measures must start at the headwaters where the floods and silt loads originate.

As has been pointed out, civilization came to Europe via Greece some three thousand years ago, and as the land of Greece declined, the center of civilization shifted to Italy and the western Mediterranean. When most of the Mediterranean lands were depleted, the civilization was overwhelmed by barbarians, and after a few centuries of a dark age, a new civilization grew up with its center in Northwest Europe. The history of Chinese civilization is similar. Civilization is about four thousand years old in China, but only the setting and details differ to any considerable extent from the story of European civilization. The main differences seem to be that Chinese civilization is about one thousand years older and the decline of both the land and civilization is about one thousand years further advanced than in Europe.

Chinese civilization originated about 2,000 B.C. in north China, probably in the loess-hills region of the Yellow River Basin, possibly in the Tarim Basin. It spread from the interior to the coastal plains of north China, and for about fifteen centuries civilization flourished in this region. Then it spread to the Yangtze Valley in central China and to Manchuria around 500 B.C. By this time, the original Chinese civilization was disintegrating, and a dark age ensued, from which arose a practically new civilization. The center of this second civilization shifted to the south, and only in medieval and modern times did it reach the extreme southern part of China.

Today the best farm lands of China are in the region south of the Yangtze River, where civilized men have lived for the shortest time. This region is also the most progressive and most prosperous (perhaps we should say the least poverty stricken), if those parts of Manchuria that were recently industrialized by the Japanese are excepted.

It is true that the Communist regime following World War II located its capital at Peking in north China, but this city was not selected because the center of wealth and population is there. It was chosen mainly because the center of Communist influence is there, and this is partly the result of the poverty of the region.

North China as a whole is a barren and poverty-stricken country, where most of the uplands, especially the loess-hills region, are severely eroded and support only a scant population of underfed and underprivileged people. Conditions are so bad over most of the region that some historians again offer the "change of climate" theory to explain why the original home of Chinese civilization is now so desertlike. Yet floods continually ravage the coastal plains near the Yellow River, which drains most of northern China, and the Yellow Sea got its name from the silt loads of the loess-hills carried down by this monstrous river, now commonly known as "China's Sorrow."

South of the Yangtze River conditions are not quite so grim, but even here population pressure on the land is great in most localities. The remaining good land must be farmed intensively, and too often it is not farmed properly. Over large areas the Chinese have built bench terraces which conserve soil although they were not

built for that specific purpose--they were built to make irrigation of the rice fields possible. Erosion continues to ruin much of the land, reducing China, as a whole, to the status of a poor country with poor and undernourished people, mainly because the land has been misused for so long.

China is an underdeveloped country, according to twentieth-century American standards, because approximately 80 per cent of the people must toil in the fields to produce enough food to ward off starvation. As is usual in old countries where the land has been dissipated and population density is great, intensive cultivation of small patches of ground seems the logical way to avoid starvation. The people do not have the time and opportunity to develop other resources, and they are unable to develop an efficient system of large-scale farming.

China has enough productive land left to support its present population at a much higher standard of living if all the land and water resources could be developed and conserved according to the best-known methods, but it is doubtful whether the Chinese will ever be able to institute such a system of conservation and use without outside help.

Ceylon is not of great importance to twentieth-century world civilization, but the history of land use there is interesting. The ancient Singhalese of Ceylon created one of the most advanced civilizations of their time in an area that is now an almost depopulated desert and jungle. They built their civilization on one of the most remarkable irrigation systems of ancient or modern times.

A group of hills and mountains rise in central and southwestern Ceylon, while the northern and eastern parts of the island are flat or rolling plains. The annual rainfall in the hill section ranges from 100 to 250 inches, most of it coming during the monsoons from May to November; but the rainfall on the plains, where extended droughts are common, drops to as low as 25 inches annually and is quite irregular.

Agriculture without irrigation was too uncertain on the northeastern plains to support a permanent civilization, but the hill and mountain regions had an unhealthy tropical climate, so the ancient Singhalese chose the drier region and irrigated it. Although the irrigation works, which used the system of gravity flow almost entirely, were started about 500 B.C., they were planned and surveyed as accurately as could be done with modern survey instruments. The Singhalese constructed stone anicuts in the streams to divert part of the flow to canals, which led the water along ridges to large reservoirs that were located at the highest possible elevations and completely surrounded with earth embankments. Dozens of these large reservoirs were constructed, several of which covered four to six thousand acres and had earthen dams from forty to ninety feet high surrounding them. During the rainy seasons enough water was stored in these reservoirs to irrigate crops during the dry seasons. Canals led from the large reservoirs to smaller ones at slightly lower elevations, and from these to the grain fields on the lower plains.

This remarkable irrigation system was expanded for more than a thousand years, and by A.D. 500 practically all the irrigable land of the island was under irrigation. The irrigation system and the civilization was maintained until the twelfth century. As the population increased, the Singhalese were apparently not satisfied with farming the relatively flat irrigable lands; also, they doubtless wanted timber from the forested hills. They cut the trees from the upland forests, causing runoff and erosion to be

greatly accelerated. Because of neglect or barbarian invasion, floods and silt washed out or filled up the diversion canals, and with the reservoirs dry, famine depopulated the island. Civilization disappeared about A.D. 1200. Today only the ruins of the cities and temples and the breached and silted remains of the huge canals and reservoirs remain to tell the story of this once great civilization.

During the period of barbarism that followed the fall of the ancient Singhalese, the land largely recovered. When the Portuguese, Dutch, and British came to the island in the sixteenth century, the hills of Ceylon were again covered with forests, and the barbarian natives were practicing a shifting agriculture in the wet, tropical hill-region. Now we shall see what this new occupation by civilized men has done to the land.

In 11878, Thwaites, director of the botanical gardens, in a letter to the governor general of Ceylon, stated: "It must have made itself painfully evident to many of the older residents of the island that great changes have been brought about by the deforesting of large areas. From this deforesting has resulted much washing away of valuable surface soil, which cannot be replaced and which has found its way into the rivers, or has been deposited on lower lands, thus covering large areas with silt and interfering with native cultivation."* *(*Ceylon Sessional Paper III,* 1931, *Report of the Committee on Soil Erosion,* 6-7.)

By 1931, the situation had become so serious that the British government appointed a special committee to study soil erosion and recommend appropriate governmental action. This committee found severe erosion over practically all the cultivated land of the island and recommended drastic legislation to regulate the use of privately owned lands as well as government lands. Ceylon is making some progress, but erosion is still so severe that it threatens to destroy many of the valuable tea and rubber plantations. The silt load in most streams is so great that it is impractical for engineers to construct irrigation works that would supply water to the semiarid plains on which the ancient Singhalese civilization was built.

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While the continent of Europe was being enveloped in the Dark Ages, there arose on the American continent a brilliant civilization--that of the Mayas of Middle America. Although it was not alone--archaeological research has recently shown that there were five contemporary centers of civilization in the Mexican-Central American area--it reached the greatest heights. True, it was a stone-age civilization: the Mayas had no metal tools, no beasts of burden, and never discovered the principal of the wheel or how to lay the keystone of a true arch. Nevertheless, they built magnificent cities of great stone temples, delved into the mysteries of the heavens and higher mathematics as no other semi-civilized people has done, and alone in the Americas developed a system of hieroglyphic writing.

Although there is no general agreement among authorities about the origin of Maya civilization and whether it grew entirely from primitive Indian cultures or received its seeds from Asia, it is certain that it reached its highest level in the tropical forest of the Petén region of northern Guatemala. If it also arose in the same region, as seems likely, then the Maya civilization is probably the only civilization that grew from a nonirrigated agriculture without outside help.

It was an agricultural civilization, based on the growing of maize, with beans, squash, sweet potatoes, and the cacao bean (on the Pacific Coast) as the other

important crops. The highland area, with every advantage of climate and soil, did not contribute much to the culture of the people--the lowland area north and west of the highlands, low-lying limestone country from one to six hundred feet above sea level, was the brilliant center of the intellectual achievements of the Mayas. It. was an area of dense forests, heavy rainfall, and many lakes and ponds. The land has long since reverted to jungle, the lakes have become swamps as a result of silting, and the region today is virtually uninhabited. Eventually the Mayas had to move or perish. They did both. Historians and archaeologists have advanced a number of theories for the removal of the Mayas, among them conquest by Mexican peoples, civil wars, and the failure of their primitive methods of agriculture. The evidence remains today, however, that because of erosion and the filling of the lakes with mud, an increasing population could not be supported in the region, either for food or, in the dry season, for water.

The story of the Aztecs of Mexico is similar to that of the Mayas, though their civilization was later in point of time; in fact, it was still flourishing when the Spaniards arrived in their midst. We do not know how long the Aztecs might have maintained their civilization if the Spaniards had not come, but we do know that the original home of the Central American Indians' civilization had already reverted to jungle. Today it is a desolate, almost uninhabited area of wet-weather lagoons, and eroded hillsides clothed in jungle growth.

The same story, with variations, was repeated in the mountains and coastal plains of Peru, where the Chimu and Nazca Indians developed a civilization in the fertile valleys of the perennial streams that came from the Andes and flowed across the desert plains to the Pacific Ocean. These valleys originally afforded an environment similar to that of the Nile, but on a much smaller scale.* (*If it were not for the fact that a preponderance of archaeological evidence, to date, shows that the original Maya civilization predated that of the Chimu and Nazca Indians by several centuries, the authors might advance the theory that the first American Indian civilization originated in these irrigated valleys of western Peru.) Deforestation of the uplands made intermittent streams of many of the rivers; and, when water was no longer available for crops during the dry season, the center of this Indian civilization gradually moved to the uplands in valleys of the Andes, where living was more rugged but the water supply was more dependable.

When the Spaniards discovered this coast in the sixteenth century, it was dominated by the Inca Indians who lived in the higher valleys of the Andes. The Incas, who were taking heroic measures to save their soil, had constructed bench terraces on nearly all the slopes where there was enough soil for cultivation, but they were fighting a losing battle with nature. It is problematical how long their civilization would have survived, but it seems fair to assume that the Incas had only a few more generations of wealth and power ahead of them, even if the Spaniards bad not come.

The story goes on and on, but now we must leave the ancients and turn to the moderns.

Soil erosion has accelerated to an alarming extent over most of the world during the twentieth century, and nation after nation reports that erosion, hitherto unnoticed, has become devastating during the past few decades. Some countries that report such acceleration of erosion have been occupied by civilized men for thousands of years,

while others have been occupied for only a few generations.

For example, Burma, India, Pakistan and other Asiatic countries that have known civilization for two thousand years or more report that erosion has been most serious during the past thirty to forty years. New Zealand, the Union of South Africa, Australia, Central America, South America, Canada, the United States, and other newly settled regions report that erosion has been most serious during the past fifty to sixty years.

Why should some of these Asiatic countries, after thousands of years of land abuse by civilized men, suddenly become alarmed about the menace of soil erosion? Why should some relatively new countries become acutely concerned about this problem at the same time? Undoubtedly a part of this concern arises from the fact that many people are just becoming aware of a condition that has existed for centuries. In other words, people are becoming more erosion conscious, awakening to the fact that widespread erosion can ruin them. Nevertheless, all of the recent alarm about erosion is not due to the late discovery of its significance. The fact is that there has probably been more man-induced erosion over the world as a whole during the past century than during any preceding thousand-year period. There are many reasons for the recent rapid acceleration of erosion, but the principal reasons are that the world has more people and the people are more civilized and hence are capable of destroying the land faster.

A great increase in the world population during the past century has put greater pressure on the land, causing more land to be cultivated more intensively than ever before. A great deal of the newly cultivated land is not suitable for cultivation unless it is handled with extreme care; in times past, only a shifting agriculture or grazing culture was practiced on it. While much of it is sloping and easily eroded by rain, some is on the fringes of deserts and is highly susceptible to wind erosion. In other words, as people ran out of good land that was easily protected against erosion, they started farming the marginal lands and, as a consequence, erosion has accelerated greatly in these areas.

The advanced civilization of the twentieth century has had adverse effects on the land in several ways. The very fact that many people have achieved a high standard of living and are eating better has put an increased load on the land, but the chief reason why twentieth-century civilization has been so destructive to the land is because it has given people more and better tools with which to exploit the land. Modern tractors, bulldozers, gang plows, and other mechanical devices made it possible to clear and destroy land faster than any of the ancients ever dreamed possible.

Another reason for the recent acceleration of erosion in many parts of the world is the transplanting of European agriculture to foreign lands with adverse climates. As has been previously noted, Western Europeans have taken substantial parts of their civilization to most other regions of the world during the past three centuries. Along with other things, the Europeans usually have tried to transplant their agricultural methods to most areas where they have gained a predominating influence. This is particularly true for most of the Americas, South Africa, Australia, New Zealand, and parts of Asia. One of the primary reasons why European agricultural methods have proved so destructive in other regions is the presence Of relatively steep slopes and the prevalence of thunderstorms. Northwest Europe's farming methods were geared to

relatively flat lands and gentle rains, and hence proved destructive to the land in many regions where they were transplanted.
Now for a brief look at some of the modern countries that have been neglected thus far.

ABOVE: *Bench terraces in the Philippine Islands. The Filipinos have pushed their cultivated fields onto the steepest hillsides. The bench terraces shown here not only check erosion, but also make irrigation possible for rice production.*

(Photograph by Hugh H. Bennett, Soil Conservation Service)

BELOW: *Harvesting grain, roots and all, in China. These Chinese farmers harvest their grain crop by pulling the plants up by the roots. In order to save every kernel, they thresh the grain by hand. Part of the straw is used for livestock feed, and the rest of the straw and the roots are used for fuel. This indicates the extent to which farmers must go to survive after erosion and overpopulation have limited them to a few square yards of productive land.*

(Photograph by Walter C. Lowdermilk, Soil Conservation Service)

The way man-made deserts start. The huge dust storms that came to the Great Plains in the 1930's were largely a result of plowing land that was unsuited for farming and leaving it unprotected against the wind. This one happened in Colorado. American farmers may create a permanent dust bowl on the plains if they continue to use the land as they have in the past.

(Photograph by the Soil Conservation Service)

Most of the arable land in Central America, including Mexico, is already severely eroded. There is great population pressure on the remaining productive land in many localities, and the rate of increase in population is high in most countries.

This region has either a semitropical rain climate or a semidesert climate. A large part of the potential farm land in the wetter regions either has steep slopes or is too wet for cultivation without drainage, and in the more arid regions wind erosion is a problem. Both the climate and the topography are conducive to rapid erosion. Furthermore, the leaching of plant nutrients from the soil is often great. Deforestation of the hillsides in the nonfarming areas has proceeded at a rapid rate during the last few decades, causing serious floods and siltation problems in many areas.

There is an urgent need for a comprehensive soil and water conservation program over most of Central America. The time factor is important, for the region cannot support its increasing population many years at the present rate of resource destruction. In fact, many countries are unable to support present populations at a standard of living that induces progressive civilization.

Most of these countries are likely to become increasingly more backward and underprivileged unless drastic steps are taken in the immediate future to conserve the natural resources and bring a better balance between populations and resources. With the present high rate of illiteracy, it is doubtful whether many of them will be able to achieve a solution in time, unless they receive outside help.

Somewhat the same situation prevails in a number of South American countries as in Central America, and the same can be said for most of the West Indies. Brazil, Argentina, Paraguay, Uruguay, and Bolivia have more good land left than most Latin American countries. Argentina is probably in the best position, with her still undeveloped prairies and plains. Brazil has much undeveloped land, but it consists mainly of tropical jungles that require great hardihood for development and do not last long in cultivation unless protected scrupulously. But with the present accelerated rate of erosion, it is only a question of time until these countries, too, will face a land shortage unless they begin conservation efforts.

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The primitive inhabitants of South Africa were living more or less at peace with nature and the land was largely intact when civilized men from Europe began to colonize and exploit this region. First the Dutch, and then the British, not only exploited the land for the sustenance of Europe and European colonizers, but helped induce an enormous growth in native populations. During the past three centuries and especially during the past fifty to sixty years, the people of South Africa have probably surpassed those of United States in land destruction. Erosion is severe throughout the Union of South Africa.

When Hugh H. Bennett, chief of the United States Soil Conservation Service, visited South Africa in 1944, he observed: "One very large area in Natal that I examined in detail presented a pitiful spectacle of completely devastated land, with both topsoil and subsoil washed off down to bedrock, and the people generally stranded. . . . In another locality we found a solid block of more than 100,000 acres of formerly good land which had been stripped of its topsoil. . . . Present yields of corn on such land range from nothing to about three bushels per acre--destructive erosion is underway over practically the entire regional wheat belt. Formerly the best wheat lands of the Union, many of them had to be abandoned because the soil had been so thinned down over the basal rock that it was no longer deep enough to plow. . . . Over a great part of the Karoo, erosion is fast spreading disaster over millions of acres. . . . In general, bad conditions of erosion are so prevalent that there must be put into effect, without more delay, a vigorous national soil conservation program, if South Africa is to survive in any sound agricultural sense. About half of the virgin fertility of the land has been lost-and the rate of erosion is increasing. Three or four decades of doing nothing will see the southern half of the continent fading from the scene. . . . There may still be diamonds to mine, and gold there, but these have no nutritional value."* (* "Land and the Union of South Africa," *Soil Conservation Magazine,* Vol. XI, No. 2, (Aug., 1945), 35-6.)

Much the same situation as Mr. Bennett depicts for the Union of South Africa exists in parts of Rhodesia, Tanganyika, Kenya, Uganda, Southwest Africa, and many other African provinces. Soil erosion is also severe and is rapidly accelerating over most of India, Pakistan, Burma, and other regions of Asia. Large areas in Indo-China,

Thailand, Indonesia, and the Philippines are also suffering. Population pressure and the backwardness of the people in most of these countries almost preclude a satisfactory solution to their land problems unless they receive much technical aid and less exploitation from the more fortunate countries of the world.

In 1944, the soil erosion officer for the Shan States in Burma stated: "During the past two decades soil conditions have deteriorated at an alarming rate. . . . Crop yields have fallen off considerably as a result of soil wash and many fields have now been permanently abandoned owing to rill erosion and gullying. In the dry season springs have ceased to flow and wells have dried up; while during the rains, flooding, silting and scour have ruined much land, destroyed houses and damaged bridges and embankments on important roads and railways."* (*T. S. Thompson, *Soil Erosion and Its Control in the Shan States, Burma,* 1.)

As early as 1929, Albert and G. L. C. Howard reported the situation in India: "Thousands of acres of valuable land on the left bank of the Jumma have been destroyed by the formation of a network of ravines which produce little more than a crop of grass in the rains. . . . Less striking than the ravine lands of the Jumma, but far more extensive and therefore more important, is the erosion which goes on on the soils of the peninsula--in Central India, Gwalior, the Central Provinces, and Bombay." * *(*The Development of Indian Agriculture,* 12-13.)

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We could go on and on with citations of land abuse and hunger in all parts of the world, but now we shall turn to a few areas where the picture is not quite so dark. The United States has plenty of good land left to support an increasing population, provided it is properly conserved.* (*See Chapter 12 for a detailed discussion.) Canada, too, has land for an increasing population, although there is not as much really productive land as is frequently assumed. Erosion is already becoming severe in parts of Canada, and it will be necessary to institute a proper conservation program in the near future if Canada's present prosperity and progress is to continue. Argentina and Brazil, as has been pointed out, have considerable areas of land not yet fully developed, but they will soon face serious conservation problems. Australia is in much the same position as Canada and Argentina. Parts of Central Africa and some other areas still have a surplus of good land, provided it is properly used and conserved. Then there is Russia.

Soviet Russia at present is the second most powerful nation in the world, primarily because she has more good land and other natural resources than any other nation except the United States. The potential productivity of her land may even exceed that of the United States. The standard of living of the people of Russia is well below that of Americans and certain other Western peoples because the resources have not been developed as rapidly as in these other countries.

Throughout medieval and early modern times, the Russians were a backward people compared to their neighbors in Europe and Asia. During medieval times, the Slavs gave their name to slavery not because they were an inferior race, but because civilization lagged in the area.

The land of the present Union of Soviet Socialist Republics has been a dominant factor in the history of the region. In European Russia, the relatively harsh climate with its extremes of heat or cold, the huge forests with the large numbers of wolves

and other carnivorous animals, and the relatively flat terrain with the consequent marshes and poorly drained farm land prohibited civilized settlements during the Middle Ages and early modern times. The vast stretches of desert, steppe, and tundra in Asiatic Russia were suitable only for nomads up to the twentieth century. These features of the land delayed the economic and cultural development of the region.

But these land and climatic features that caused economic and cultural backwardness have also preserved Russia's natural resources. In European Russia, the relative flatness of the terrain has prevented really harmful erosion, the cold winters have protected the land by keeping it frozen and covered with snow during part of the year, and the hot, dry summers have helped prevent excessive cropping and leaching of the soils in the Ukraine and other parts of southern Russia.

In Asiatic Russia, the climate and vegetation, and the consequent system of nomadic grazing, have helped to preserve the soil, while the huge forests, marshes, and tundra have always supplied the Russians with an abundance of timber and wildlife. In other words, Russia still has most of her original natural resources-which are probably in a better state of preservation than any others in a habitable region of comparable size in the world.

It should not be assumed, however, that Russian soils have not been damaged by civilized man. For at least one thousand years, the steppes have been overgrazed, frequently with a loss of productivity. The once productive farm land in the states of Turkmen, Uzbek, Tadzhik, and Kirghiz, on the southern edge of Asiatic Russia and in the Caucasian region of European Russia, has been severely damaged during the last two thousand years. About six hundred years ago, this region, which has been on the fringes of civilization from the times of the ancient Persians and Alexander the Great, was the seat of one of the most powerful empires in the world-that of Tamerlane. Now this region, which did have some of the most fertile farm and pasture land in the world, produces but a fraction of what it did six to eight centuries ago. Yet this land can be, and is being, developed at the present time so that a substantial part of its former productivity may be restored.

Certain parts of Russia have been depleted by misuse and water and wind erosion, but, on the whole, the land in European Russia and Asiatic Russia has suffered little damage. The land still has potential productivity, and only needs proper development and protection to make Russia one of the largest areas of good farm and pasture land in the world.

Russian history illustrates how abundant natural resources can create great national strength. From the beginning of recorded history, almost every generation of Russians has fought one or more wars. The Russians have lost more wars than they have won, have been defeated in battle many times, have been forced to sign ignominious peace treaties, and have actually been conquered and forced to pay homage and tribute. Yet Russia has continued to grow in strength and importance among the nations of the world. In some thirty generations, Russia has advanced from an obscure outpost on the fringes of civilization to one of the foremost powers of the world.

Why? Mainly because their conquerors never took the Russians' land from them. The Norsemen (Varangians) came down the rivers of Russia during the ninth and tenth centuries, subjugated the Slavs living along the Dnieper and other rivers, and sold many of them as slaves in the markets of Byzantium, and later in western

Europe. Although they set up trading centers along the waterways, established commercial outlets with the Byzantine Empire, and controlled Russian labor and resources to a limited extent, they never exploited the land and were eventually absorbed by the superior numbers of the Russians. Actually the Varangians may be largely credited with bringing civilization to Russia.

In the thirteenth century, the Mongols conquered most of Russia and ruled it for more than two centuries. The Mongols did not take the land away from the Russians, either, but merely exacted homage and tribute. In fact, as their power declined, the Mongols bequeathed most of the present vast empire to the Russians. The Turks, Poles, Lithuanians, Swedes, French, British, Japanese, and Germans all appeared to win wars from the Russians, but none of them occupied and used any significant part of the vast land resources.

The great internal strength of Russia--the huge forests of the north, the immense marshes and lowlands of the west, the large acreage of black farmland in the Ukraine, the vast stretches of steppes and tundra across eastern Europe and Asia, and the rich mineral resources of the Ural region, Caucasia, and Siberia--remained largely intact and undeveloped until the twentieth century. The conquerors did not want to live on and develop these rich lands, for the climate and terrain were too forbidding. But it was this land which contained the resources which produced the food, shelter, clothing, and industrial materials that enabled the once despised Slavs to increase their numbers and advance their civilization. Each time an Ivan, a Peter, a Katherine, or a Stalin came along to give aggressive leadership to the Russians, they gained back most of the land they had lost in previous wars and added more to their already vast resources.

In spite of reverses on the battlefields, the enslavement of large segments of the population, and the tyranny of absolute monarchs, Russia continued to grow in size and strength. With the natural resources of half a continent to draw upon, the Russians borrowed the technology of their neighbors and would-be conquerors to develop these resources, so that today those neighbors and would-be conquerors stand in awe of the might of Russia.

We shall not think of Soviet Russia as the center of present-day world Communism. That may be quite temporary. Rather, we shall consider Russia as a large mass of land inhabited by some two hundred million people, who are of neither a super nor an inferior race. Only about one-half of the people are Great Russians, who, themselves, are a mixed race. The rest of the people are mixtures of Ukrainians, Poles, Finns, Letts, Lapps, Esthonians, Lithuanians, Hungarians, Ruthenians, Turks, Mongols, Tatars, Georgians, Jews, Germans, Czechs, and others. Although the population is steadily increasing and industrialization has been rapid in recent years, Russia still has potential resources for further increases in both population and industry. Russia will remain a dominant world power, and her power will probably increase, regardless of the form of government, as long as she retains control of her present vast resources--that is, if her technology of production and conservation keeps pace with the growing population.

At present, the advancing technology of Russia, borrowed largely from Western Europe and the United States, seems adequate to develop the natural resources fast enough to catch up with the growing population. The standard of living of the people

has continued to rise throughout the twentieth century, and especially during the last three decades. But along with this development of resources has gone exploitation and land damage. The mechanization of many Russian farms has undoubtedly speeded up the land-destruction process, just as it has in the United States, and the collectivization of the farms has also hastened this deterioration, as communism in farming usually does. Although the Russian government has recently recognized the dangers of land exploitation and has started a soil conservation program, there is no way to tell how effective this program is, since it was started after the Iron Curtain was lowered.

The main handicap of the Russians, at present, is their political system, which should be considered only a temporary handicap that can be changed by the will of the people, as forms of government have always been changed. The Russians now have a semi-communistic, totalitarian form of government. In the past, communism has nearly always delayed progress in technology and in agricultural and economic development, while, on the other hand, totalitarianism, or dictatorship, has usually incited technical and economic progress--as well as war. The combination of these two types of government makes the future of Russia very unpredictable, but regardless of politics or ideology, a fully rounded program of conservation is essential there, as elsewhere, for continued progress and prosperity.

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Now for a brief look at some of the European countries thus far ignored, and then at Japan. Some of the small nations in Central and Eastern Europe (Poland, Hungary, Czechoslovakia, Yugoslavia, Bulgaria, Albania, and Romania) are finding it difficult to offer their present populations an adequate diet. This area as a whole has adequate land to support present populations at a relatively high standard of living, and if all the land were efficiently developed and used, the region could support a moderate increase in population. The population density is about 190 persons per square mile, which means approximately three and five-tenths acres per person. Since about 60 per cent of all the land is suitable for cultivation or good pastures and meadows, there are about two acres of food-producing land for each person.

The land in a few areas of this region has been seriously depleted by erosion. Although some of the land depletion dates back to Roman times, a great part of the arable land was not seriously damaged until the twentieth century. The rather sparse population and relatively primitive farming methods during medieval and early modern times saved most of the land from serious abuse. The greatest land damage has come during the last few decades, but a good conservation program could make this region self-sufficing for generations to come.

Since World War II, however, communism, which seldom encourages conservation, and mechanization, which usually induces exploitation, have thwarted conservation and agricultural development of the farm land in most of this region. Thus, the outlook for Central and Eastern Europe does not seem particularly bright at present.

In Japan, where civilization is about fifteen hundred years old, there has been serious erosion in many sections. The steep slopes and heavy rainfall were conducive to erosion over a greater part of the main islands. Yet the Japanese succeeded in bringing most of the erosion under control by modern times, and during the last century, there has been destructive erosion only in small scattered areas.

The Japanese have devised and used conservation methods that are expensive, if

measured in terms of human labor, but effective. In spite of dense population (about five hundred persons per square mile), nearly two-thirds of the land is in forests, which are under state control, with a rigid conservation program. Although less than 20 per cent of the land is cultivated, it is cultivated intensively. Large quantities of chemical fertilizers are applied, and erosion control is practiced scrupulously on most land. Nevertheless there are areas where active erosion is severe. In general, however, these people have been true conservationists for the past few generations.

Japan has not always been so thickly populated. The main population growth has come during the past century. The standard of living has not been high, the diet consisting basically of rice and fish. The Japanese, who depended on the exploitation of other lands and peoples for a large part of their sustenance during the half-century immediately preceding World War II, followed the familiar pattern of taking land and resources away from their neighbors as their population outgrew home resources. Since World War II, the Japanese have had to rely almost entirely on the resources of their homeland. Will the population pressure cause land deterioration and a further lowering of the standard of living of these people? Or will they be able to avert these catastrophes that have befallen all previous peoples in like situations? Only time can give the true answers to these questions.

12. THE UNITED STATES

THE HISTORY of the United States, up to now, follows closely the pattern set by the ancient empires and civilizations. The main differences are that the people of the United States had a larger area of rich land to exploit than any of the ancients, and with their better tools and machines they developed and exploited the natural resources faster. The rapid rise and phenomenal material wealth of this nation were due to these facts. We shall now trace briefly the history of resource development and use in the United States and note the similarities to other regions discussed.

North America was probably discovered by the Norsemen about one thousand years ago, but for practical purposes, the discovery should be dated with Cabot's voyage of 1497. For the next century, the Spaniards, French, British, and others toyed with the idea of colonizing North America, but little progress was made. The few colonies established were temporary. The early colonists were seldom seeking a new home, but were basically interested in silver, gold, and other forms of superficial wealth. Thus the sixteenth century might best be called a period of discovery and exploration.

Early in the seventeenth century, Western Europeans who actually came to North America to find a new home established permanent settlements along the Atlantic seaboard. Many of these early settlers were fleeing from religious persecution or tyranny at home, while others were subsidized by the governments or rich noblemen of their homelands. These people proved that it was possible to settle and make a living from the wilderness and sent back reports of their success to friends and kinsmen in Europe. This started the mass migration of Europeans to North America that gradually accelerated for three centuries--until it was checked by the immigration laws of the United States in the twentieth century.

The North American continent was a fabulous prize for colonizers. Such ancient colonizers as the Phoenicians and Greeks would hardly have known what to do about such an abundance of land and wealth so poorly defended by the natives. The area now known as the United States contained nearly two billion acres of land. Twothirds of the country was covered with magnificent forests or lush grass, wildlife of all types abounded, rainfall was adequate for agriculture over more than one-half the area, and all this land was occupied by less than two million people--mostly savages and barbarians with only bows and arrows to defend themselves.

Yet colonization proceeded slowly at first, because Europeans still had plenty of good land at home and did not need to brave the storms of the Atlantic and the wrath of American Indians to get farm land. But by the middle of the eighteenth century, the white settlers, who were concentrated along the Atlantic coast, probably outnumbered the native Indians. From this time on, the Indians fought mainly a "delaying action," trying to avoid extermination.

In the meantime, the governments of Western Europe awoke to the significance of the Americas and fought several wars to determine who should gain control of these vast resources. The defeat of the Spanish Armada by the English decided one of the early phases of the struggle for possession of North America. The Seven Years' War between England and France was one of the later phases of the struggle. The English colonists in America entered this contest--in 1755 designated as the French and Indian War--partly because they wanted to settle the rich land west of the Alleghenies. They

won that privilege, and from that time on the Atlantic seaboard from Maine to Florida was assured of being an English-speaking country.

After the English-speaking colonists gained supremacy over the Indians and other Europeans in America, they became irked at the controls imposed by the mother country, and so declared themselves independent. As every schoolboy knows, they won the war that followed and laid the foundation for the richest and greatest nation the world has known up to the present time.

The American colonists rebelled in 1775. Did they undertake this war to prove that all men are created equal? Were they trying to establish the inalienable rights of man to life, liberty, and the pursuit of happiness? It is questionable. These ideals, in which many of the colonists believed, were ably advanced by a few brilliant leaders of the time, but ideals alone have seldom caused a people to go to war. War itself is not an ideal, but a very ugly and material thing. It usually takes material things to cause a war.

The rebellion started mainly because the colonists believed England was imposing unjust economic restrictions, even a form of tribute, on them. This tribute was disguised, of course., under various names. Taxes, import duties, export duties, interest, expenses of quartering troops, and devaluation of colonial currency were some of the more common forms of extortion used. The colonists, who had taken most of the risks and endured the hardships of settling the country, had helped fight off the French and their Indian allies, and had developed the country and produced most of its wealth, resented these things. They felt entitled to enjoy their wealth without giving excessive amounts of it to the British government and favored British trading companies.

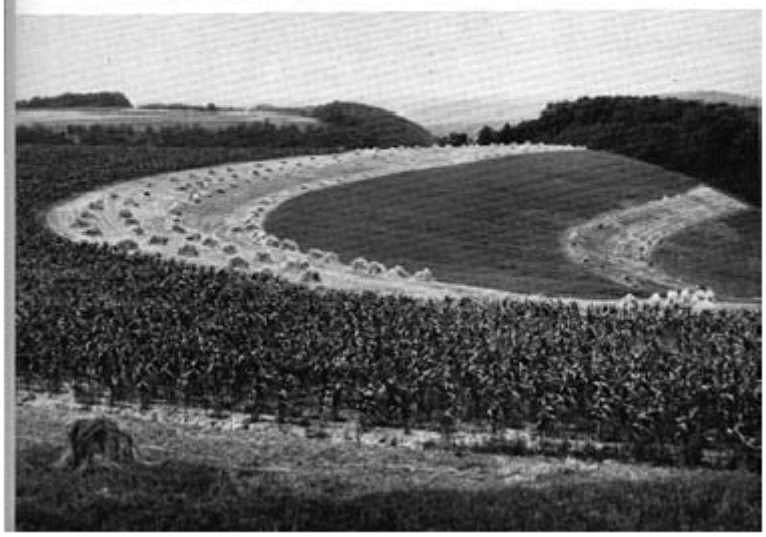
ABOVE: *Gullies grow like cancers. Once started, a gully gradually eats its way uphill, destroying the land wherever it goes, and with each heavy rain it becomes deeper, wider, and longer.*

BELOW: *Fifty million acres of American land look like this, and another fifty million acres are rapidly approaching the same condition. Once good cropland, this field is now unfit for any profitable use.*

(Photographs by the Soil Conservation Service)

Farming that fits the pattern of the land. One of the chief causes of erosion is that civilized man has consistently tried to make the land fit his pattern of farming, when he should have made his farming fit the pattern of the land. Furrows that follow the contours of the land, as shown above, help to hold both water and soil on sloping fields. The planting of strips of sod crops between cultivated strips, as on the field shown below, is a further refinement of conservation farming that fits the pattern of the land.

(Photographs by the Soil Conservation Service)



The British should be neither condemned nor excused for their various types of attempted extortion. They were following much the same procedures used by nearly all other colonizing countries, before and after their time. Nor is it necessary to justify or criticize the American colonists for their rebellion. But it should be pointed out that these colonists were also following a pattern of history. As soon as they became strong enough to feel self-sufficient, they rebelled at the extortions of the motherland. In other words, the independent American nation started in much the same way that many other independent states and nations started.

The result of the American Revolution turned out to be quite different, however, from that of most other wars of independence. Not only did the American colonists gain the right to determine their own fate, but they gained the opportunity to exploit the natural resources of most of a great continent. After they gained their

independence, the American colonists found that their only competitors for the vast stretches of rich land to the west were a few scattered tribes of Indians. With a plentiful food supply, a high birth rate, and a constantly increasing immigrant population from Europe, the colonists started their expansion westward. In all history there has never been another period of settlement to compare with that of the new and growing Republic of the United States.

Spreading across three thousand miles of land and settling it in little more than a century, these hardy colonists, or pioneers if you like--the Indians doubtless called them conquerors--endured many hardships to "settle" the continent. But they also exploited and destroyed much of the natural wealth of the land. The explorers, trappers, and hunters led the parade. Coming over the Alleghenies and to the Mississippi before the new nation was born, the trappers and hunters took fabulous wealth from the country--but they destroyed much more than they sold. They practically exterminated the great herds of bison on the plains and were almost as destructive to other wildlife.

The farmers, who followed close on the heels of the hunters and trappers, cleared the trees and grass from the land, settled the country, and made it the greatest agricultural nation of the world. While doing this, however, they also destroyed much more than was necessary. They all but exterminated a great hardwood forest that stretched from the Atlantic to the Great Plains, they killed most of the wildlife that the hunters and trappers had left behind, and they filled once clear streams with mud from their eroding fields. But most important of all, they despoiled the land itself, letting the topsoil from thousands of fields wash away. Millions of acres were cut up by gullies and became unfit for use as farm land.

In the nineteenth century, modern American industry began to develop. It became one of the colossal achievements of mankind, placing more machines, implements, and gadgets of luxury in the hands of the American people than all the rest of the world had ever known. This industry, along with the agriculture, made the United States the richest nation that has ever existed, and the standard of living for the average citizen the highest the world has ever seen. But industry also took its toll on the nation's resources: It consumed much of the timber of the forests with little thought of replacement. it dug into reserves of iron, copper, lead, zinc and other ores, consuming them in enormous quantities and with much waste; it has already used up much of the known petroleum reserves; and it is rapidly exhausting known supplies of many other minerals. And now chemurgy is beginning to eat into the fertility reserves of soils, as organic plastics, made of farm crops and wood, are used as substitutes for metals.

The wealth and greatness of the United States did not grow to present proportions because the people, who are a mixture of practically every race, nationality, and tribe on this earth, are superior to the other peoples of the world. It cannot be claimed that such a mixture produces a superior race, although these people have produced a superior nation.

Some claim that the form of government has been largely responsible for the greatness of this nation, but the United States does not have a monopoly on the democratic form of government. In fact, the land and the resources have been important factors in determining the form of government. The people have had free

enterprise in industry, freedom to exploit the land, forests, and minerals, and freedom of speech and political institutions largely because the land was rich--because there were enough resources for everyone, and everybody was permitted to exploit it as he pleased, until these resources began to get scarce.

From colonial times until the end of World War I, the people of the United States prospered largely by shipping the surplus raw products of the land to nations overseas. And these surpluses were vast. First they shipped the furs and skins of the wildlife, then they shipped as much timber as foreign markets would take and burned much that was not wanted, and then the fertility of the soils was exported in the form of tobacco, cotton, wheat, corn, beef, pork, and wool. Money borrowed from Europe to help develop the resources was paid back--plus exorbitant interest at times--by shipping out the products of the land.

As money wealth increased, the nation had less and less need for outside capital, and by the end of World War I was loaning money to Europe rather than borrowing. The United States had become so rich that the rest of the world was becoming envious, but it should be emphasized that the nation had obtained this wealth by selling its natural resources to other countries.

During World War I, the United States produced the food and manpower that proved to be decisive in the war. After the Armistice, industry began to boom. Most of the agricultural land had been occupied; no longer could population and wealth be expanded by settling more land and shipping its produce abroad. Therefore, industrialists turned to mass production of machinery and labor-saving devices. The country had the necessary mineral resources, so that by the time of World War II, the United States was ready to furnish not only the food and manpower but also a large part of the arms, munitions, and other equipment needed to win the war. It finished that war not only the richest but also the most powerful nation on earth. It achieved this position because nature made the land wealthy long before it was settled by civilized white men.

The waste in settling this country was appalling, just as it has nearly always been when civilized men moved into a new and undeveloped country. There were some conservationists, of course, as there were in most other countries. George Washington and Thomas Jefferson urged contemporary farmers to practice conservation, and Patrick Henry once said, "Since the achievement of our independence, he is the greatest patriot who stops the most gullies." But most early Americans found it easier to take another farm away from the Indians than to conserve the land they had.

During the few generations this nation has been occupied by civilized man, the land has been severely abused. Gullied and sheet-eroded hillsides can be seen by the hundreds in a cross-country ride in any region. The gullies are not just to be found on fields that have been cultivated for generations, but also on hundreds of thousands of fields that are still farmed by the men who broke the sod or cleared the timber. Little of the land is as good as it once was.

How about the streams? In 1634, Father White, an Indian missionary, wrote of the Potomac River: "This is the sweetest and greatest river I have ever seen. . . . There are no marshes or swamps about it; . . . its waters are clear and sweet. . . . It abounds with delicate springs." Compare that description with the muddy Potomac of today. And it is not necessary to confine your comparisons to the Potomac, since the same thing has

happened to nearly all the streams of the continent. The harbor at Baltimore, Maryland, has been pushed downstream more than six miles in the last two hundred years. Silt has filled the formerly deep channel of the Patapsco River so that it is no longer navigable, and it is coming down the river more than ten times as fast as it did when Baltimore was built. To dredge out the mud and keep this harbor open now costs more than $100,000 a year. The same thing is happening to nearly all of the great harbors and navigable streams. The fish are gone from most of the streams, too, suffocated with mud or killed by man's poisonous refuse. Thousands of reservoirs have been built along streams only to be filled with silt in a few decades. And in the meantime, it is becoming increasingly difficult for many of the cities and industries to get an adequate water supply.

Why do floods become larger and more frequent with almost every passing decade? This also is a result of the mistreatment of the land. Grasslands were plowed up or overgrazed, and forests that soaked up and held back the flood waters were cut. Steps were not taken to hold rainfall on the cropland where it fell. Engineers thought they could control the flood waters after they reached the mud-filled river channels by building dykes higher and higher, but the rivers still broke over. At this rate, the lower courses of American rivers will soon be like the Yellow River of China--flowing in built-up channels that are higher than the surrounding plains. This is already true, to some extent, of the Mississippi, the Colorado, and other rivers.

Why did the huge dust storms blanket the nation from 1934 to 1938 and again in the 1950's? For the same reasons that the topsoil washed away, rivers and harbors became clogged with silt, and the menace of floods haunts us--the land was misused. The grass of the plains was plowed up without adequate provision to protect the land. Droughts have come to the plains for thousands of years, and strong winds have blown, but the dust storms came only when the ground was left bare and unprotected, and they will come again, worse than ever before, if land-use methods are not changed.

The early Americans were following a pattern as old as civilization and should not be unduly criticized for their waste in settling the country. They caused more waste and ruin in a shorter time than any people before them because they had more land to exploit and better equipment with which to exploit it. Some ruined their land because they knew no better, and others destroyed out of greed for immediate profits, but most of them did it because it seemed the easiest thing to do. The federal and state governments actually encouraged exploitation and waste in some instances, but more often they simply permitted it.

We all wonder what the atomic age has in store for us. Maybe we can get along without our fishing, hunting, and other outdoor sports, and maybe we can do without parks, forests, and other natural recreation spots. Although it would certainly be distasteful to most of us and probably less healthy for everyone, the human race might adapt itself to an environment of brick, stone, concrete, sand, and mud. This ingenious animal, man, will probably find substitutes for those minerals that are becoming scarce and develop substitutes for his depleted fuel resources. But he still has to eat. The world has enough productive land to feed the human race, but there is not much to spare. With a few more generations of waste, famines will not be confined to India, China, and war-devastated areas--they will be world-wide. Naturally, the most

important question that arises near the end of a discussion such as this is whether our nation and civilization have to follow the path of decline taken by all previous civilizations? The answer to that is obvious. No! Just because all ancient nations and civilizations despoiled their environments and gradually degenerated is no reason why we must necessarily do so, too.

The people of the United States have at least three distinct advantages over the ancients. We have the lessons of history before us and know, or at least we should know, that conservation and wise use of natural resources are essential for survival; we have the technical and practical knowledge necessary to conserve the renewable resources while still using them and to develop substitutes for the nonrenewable resources; and we have far superior means of communication, by which we may teach the lessons of history and transmit the knowledge of conservation to all the people. If we will but use these advantages, there is no reason why this nation and this civilization cannot continue to prosper and progress for thousands of years to come.

One of the reasons for studying history is to learn from the experiences of our ancestors, but it benefits man little to learn these lessons if he is unable to interpret them properly. Civilized men of the past have seldom been able to interpret and apply the lessons of history. Usually they believed that their problems had no parallel in history, for the details and confusing embellishments deceived them into thinking that their particular problems were unique and demanded an extraordinary type of treatment. And nearly always the types of treatment devised, regardless of the types of problems involved, were man-made laws or man-made force.

Extermination or enslavement of fellow human beings has been the favorite solution for all kinds of problems throughout history. Man-made regulations, covering everything from the planting of crops to religious worship, have also been tried in solving all types of problems. Of course, conquest, extermination, enslavement, and regulation of human beings have solved few of the fundamental problems that confronted former civilizations. Sometimes they postponed the decline of civilization, but more often they hastened it. We must learn, if we are to survive, that the fundamental base for our civilization is the natural resources on which it rests--that our plan for survival must start with an intelligent program for conserving and using those resources.

We have an almost wholly literate people in the United States, where public and private school systems reach nearly all youths and many adults. Means of transportation are rapid, and the opportunities for public discussion are more numerous than any people ever enjoyed before. Newspapers and radio broadcasting systems reach most homes, and television and motion-picture theaters serve those who prefer to get their information visually. There is no reason why almost 100 per cent of our population should not be properly informed about these essential matters--these things that will affect the future standard of living and may even determine the future status of civilization. But misinformation can be imparted almost as effectively as correct information. We must evaluate our problems and devise solutions for them if we are to rescue this civilization from the pitfalls that lie ahead.

More is now involved in saving our civilization from self-destruction than the conservation of natural resources. We must now live with the atom and hydrogen bombs, guided missiles, and who knows what. Yet it is necessary to hope, to assume

that man will not completely destroy himself through war. And the greatest hope against continued atomic warfare is that the people of the world will learn that the true source of prosperity and well-being is not the wealth that a group or a nation can seize from a neighbor, but the permanent wealth that develops from the conservation and wise use of natural resources.

One of the greatest dangers our civilization now faces is the fact that we may delude ourselves into thinking that there are easier roads to permanent prosperity. We are very science conscious here in the United States, where many seem to think that we are at last the masters of nature. It is true that science has provided such phenomena as electric power, running water, radios, and television for home comfort; tractors, bulldozers, steam shovels, cranes, and other massive machines to do our pulling, pushing, digging, and lifting; machineguns, electronically controlled artillery, Napalm and hydrogen bombs to do our killing; automobiles and jet-propelled and supersonic airplanes for travel--and atomic powered airplanes and space travel are now being considered. But probably more important, scientists think they may be able to provide an unlimited supply of man-made carbohydrates by harnessing sunlight and using it for artificial photosynthesis, and other scientists contend that they may discover a way to use the minerals and vegetation of the oceans for food.

New sources of food are not exhausted, however, with the experiments in harnessing sunlight and using ocean vegetation and minerals. Vegetables and other food plants have already been produced by hydroponics, a process for growing foods in vats of sterile gravel, water, and chemical fertilizers. And recently so-called miracle chemicals have been marketed, advertised under such trade names as Krilium and Loamium, which are supposed to change eroded, clay subsoil into productive loam. And while scientists are searching for new sources of food and new ways of increasing yields, the farmers have increased production. American farmers produced about 40 per cent more food in 1954 than in 1939 from the same land, increasing their production by 40 per cent in fifteen years in spite of the fact that their land was actually getting poorer.

Then there is the possibility of raising food from the large amounts of land that is now producing little or nothing. In the United States there are some thirty million acres of and land that could produce bumper crops with proper irrigation. Furthermore, the water required to irrigate this land is available, though the project would require extensive efforts and perhaps billions of dollars since in some cases it might be necessary to divert the flow of rivers for hundreds of miles. This task would be much easier, however, than the Phoenicians' terracing of their sloping mountainsides. Also, there are seventy-five to 100 million acres of forest, grassland, or marshland that would make good farm land, if cleared or drained and properly treated. If this good land was added to our present farm land, it would probably increase our cropland by one-fourth.

Since our economy is now tied closely to that of other nations, we should also consider some of the nonproducing lands in other countries. In southern Asia (Pakistan, India, Burma, Thailand, Malaya, and Indo-China), where more than five hundred million people live in an area not much larger than the United States, there are large acreages not in cultivation. There are areas of jungle that need only proper clearing and drainage to make them productive farm land. There are areas of

semidesert that could be made productive by proper irrigation, for the water is available to irrigate some of this land. The same situations are found in parts of China, Iran, Iraq, Indonesia, Australia, Brazil, Central Africa, and other regions. We have the technical knowledge and engineering skill to help bring these unused lands into production, and the yields from them should give all the people of the world more food and a higher standard of living. Yet there are a number of reasons why we cannot obtain an ever increasing food supply without proper attention to conservation.

First of all, artificial photosynthesis merits a closer examination. If our scientists can really learn to harness sunlight, they might obtain an almost unlimited supply of carbohydrates and might eventually produce digestible proteins. But man is a child of nature, and his digestive system and metabolism are not geared to synthetic concentrates. The health and growth of human beings are closely related to the kind and quality of the food eaten. Often the human body is affected by the quality of the soil from which the food is grown. No reputable physician or nutritionist claims that the health of the masses can be maintained on synthetic foods, else there would be no urging us to eat more of the so-called "protective foods," such as meat, milk, eggs, and fresh fruits and vegetables. Moreover, most of us still like to chew on a good steak, and we like plenty of butter on the toast that we eat along with fresh fruit juice and bacon and eggs for breakfast.

How about hydroponics? Why can't all our foods be produced from vast acreages of vats filled with sand or gravel and proper chemical solutions? There are two primary obstacles. In the first place, our chemists do not know, and may never know, exactly which elements and what proportion are needed in the solutions to grow health-giving grains, fruits, and vegetables. Secondly, the amount of labor and the expense involved are immensely greater than in raising food from good farm land. The chemical elements must be mined and processed, and the vats must be constructed--maybe from already scarce metals or equally scarce substitutes. Then vats do wear out, and the necessary chemicals may become scarce or so difficult to mine and process that the cost will be prohibitive. In other words, hydroponics may be fine as a hobby, or for soldiers stranded on an island where there is insufficient land to grow fresh vegetables, but the method is certainly not practical for growing a major part of the food for two or three billion people. That would be going backwards--back to the time when it took most of man's labor to produce the food he ate.

How about farming the oceans? Some scientists claim that it is practical to use the vast amounts of minerals in sea water to grow various types of algae, seaweeds, and other plant life that could be converted into human food through laboratory processes. This may be possible, but it is not a satisfactory substitute for soil conservation. Objections to synthetic photosynthesis and hydroponics are also valid for "ocean farming." There is a limit to the amount of useful minerals in the ocean waters, and if soil resources are depleted without much attention to conservation, the same thing would probably happen to the usable resources of the oceans.

As has been previously mentioned, the production from farms in the United States increased around 40 per cent in the past 15 years. A part of this increase was due to our national soil conservation program that has been underway since 1935, but most of it was due to better insect and disease control, to the development of better strains and hybrids of crops and livestock, to more efficient tillage and harvesting machines,

to better methods of farming, and, above all, to a 300 per cent increase in the amount of commercial fertilizer used. These things can be improved further and thus continue to increase the productivity of our farms--that is, if erosion and depletion of the inherent fertility of the land is stopped. But the increased use of chemical fertilizers, better insect and disease control, better varieties of crops, and the like will not afford unlimited increases--not if the land is permitted to continue to decline.

Farm production cannot be increased indefinitely by the use of chemical fertilizers, because chemists do not know the exact formula for a so-called complete fertilizer, since chemical requirements vary for each area, depending on what is already in the soil. The heavy use of chemicals also tends to speed up the oxidation of organic matter in the soil, and this, in turn, tends to speed up erosion, ultimately making the soil more difficult to farm. Furthermore, the cost of fertilizers will eventually become excessive, just as in the case of hydroponics. In other words, commercial fertilizers are useful to supplement the natural fertility of the soil, if other good conservation practices maintain proper soil structure and organic matter, but chemical fertilizers can never take the place of good land management.

How about Krilium, Loamium, and other miracle compounds that are supposed to make productive loam out of heavy clay subsoil? Farmers cannot sprinkle these "wonder drugs" over the eroded land and keep right on farming it as before, because these chemicals are only temporary expedients that do little more than cause the soil particles to cohere, resulting in a type of granulation of the soil. This granulation temporarily makes a heavy clay subsoil much easier to plow, and makes the soil more permeable so that more water will soak into it. But there are disadvantages to using such chemicals. In the first place, their effects are only temporary, as far as is known; certainly the effects will last no longer than it takes erosion to remove the layer of soil in which the chemicals have been mixed. More important is the fact that the granulation caused by these chemicals will speed up oxidation of the little organic matter that remains in the treated soils. This means that when the effects of the chemicals have been dissipated, the soil will be in worse condition than before. Also, these chemicals will not mix with land that is already eroded to bedrock--and that is the condition of many of our gullied fields now, and the condition many more are rapidly approaching.

How about the land in the United States and in other parts of the world that could be made productive by irrigation, clearing or drainage? Again, this is only a temporary expedient. The huge reservoirs we constructed to supply irrigation water will be filled with silt in a few generations if deforestation and erosion continue unabated in the watersheds above, and the diversion and irrigation canals will become clogged with silt, just as they did in Mesopotamia, the Indus Valley, and Ceylon. Moreover, the United States is running short of water for domestic and industrial uses in many sections, while more hydroelectric power is needed in nearly all regions. But the same water cannot be used for both irrigation and industry, and seldom can it be used for both power and irrigation. The forest lands cleared for farming may soon become unproductive if erosion is permitted to continue as in the past on our present farm lands. The draining and cultivation of marshes and swamps will become increasingly difficult if the streams and rivers continue to bring down the same huge loads of silt and mud. Furthermore, many of these marshes and swamps are more valuable for the

wildlife they now produce and the effect they have on our water supply than they would be for cropland. The irrigation, clearing, and draining of new land is not the solution. Nearly all the civilizations preceding ours tried these remedies, but they only preserved their standard of living for a few generations at best.

All of these possibilities can only be supplements or partial substitutes for good land use. If we continue to let the productivity of our land decline, these things will merely replace the production lost through bad land management. Eventually we will find that we have despoiled or used up not only our good land but the potential substitutes for it.

Since an increase in population depends upon an increase in food supplies, the question of controlling population invariably arises. Control of the world's population has been debated since the time of Malthus, and much has been written pro and con on the subject. The fact remains, however, that the study of population is exceedingly complex, requiring expert analysis and presentation. The limitation of population takes many and varied forms, aside from "birth control" in our frame of reference--such as delayed marriage, celibacy, abstinence, wars, etc. It also reflects the economic condition of the world as a whole, as, for example, the lowered birth rate in the United States during the great depression of the 1930's. In certain European countries, such as France, Sweden, and Denmark, forms of birth control have been practiced for almost a century; but in other countries, such as India or China, generations would be required for such a revolutionary idea to become a part of the general mores.

Range land produces more forage when managed properly. Although this Texas range had been overgrazed until it was almost bare of vegetation, it now produces much more forage than it did in its virgin state. It was planted in adapted native grasses and given proper protection for a few years.

(Photograph by the Soil Conservation Service)

Reforestation is needed for some eroded land. This area was denuded of its natural growth of timber and placed in cultivation. Two generations of farming almost ruined the land. It was recently included in a National Forest, and the United States Forest Service planted trees on it. Within a few years it will again be producing a profitable crop.

(Photograph by the United States Forest Service)

Certainly any need for decision in this direction is several generations away. Moreover, if we continue to squander the resources on which our civilization is based, starvation will take care of the matter. Our civilization will probably arrive at the same stage as that of the Romans when Bishop Dionysius deplored the fact that the human race was diminishing and wasting away.

Instead of thinking in terms of restricting the human race, we should consider ways of expanding the possibilities of man. These possibilities are based on a program for conservation of the natural resources on which man depends. Other solutions are simply modern variations of the old remedies which did not work for the ancients, and probably would not work for us.

If we keep in mind the fact that at one time the earth had no soil and no life, it will help us understand why the productivity of the soil can, theoretically, be increased each decade and each century, as long as the amount of sunlight and general climatic conditions remain constant. The amount of soil and the plant and animal life it supported increased throughout the ages until civilized man came on the scene. It was only when man upset the natural processes by trying to become the master of nature that soil building ceased and soil decline started.

Man has the knowledge and tools with which to destroy rapidly the soil and the plant and animal life it supports, but he also has the knowledge and tools with which to build soil and increase its productiveness much more rapidly than under natural processes. Man can apply his knowledge and skill toward soil building rather than soil destruction if he chooses to do so; and instead of making deserts of all the lands he occupies, he can make the deserts bloom.

Conservation of soil, water, plant, and animal resources does not mean hoarding these things for future use, but using them efficiently, and in such a way that they will last and become more productive. This can be done, but to do it, man must co-operate with nature--not assume that he is the master of nature. The conservationists of the United States Soil Conservation Service have a fairly simple formula for using the land while improving it. Use the land within its capabilities, and treat the land according to its need for protection and improvement.

By using the land within its capabilities, they mean that land should be used for cultivated crops only if it is capable of growing such crops indefinitely. Steep land should not be farmed if it is going to wash away in a few years, but should be planted in trees or grass for protection against erosion.

By treating land according to its needs, they mean the use of all the soil-conserving and soil-improving practices needed to maintain or increase the productivity of any given field. This includes such practices as proper crop rotation, the add-in of enough organic matter to the soil to replace that which is oxidized each year, the use of the correct amount and type of chemical fertilizers to get maximum production, the building of terraces or the use of contour strip crops on sloping fields to help check erosion, the planting of grass in the waterways to prevent them from becoming gullies, the draining of the land if it is too wet, 'irrigating it if it is too dry, and so on. By following this formula, we can conserve the soil and keep increasing the productivity of the land. R. M. Salter, chief of the Soil Conservation Service, estimated in 1952 that the production from most farm land of the United States could be increased by 75 per cent through the use of this formula and other knowledge now

available about better farming methods. And his estimation did not consider the improved technology that is bound to come with each succeeding generation.

The foresters of the United States Forest Service also have a fairly simple formula for conserving the forests while using them. They call it "sustained-yield forestry," which means that any crop of trees in any given forest are harvested only as fast as the crop grows. All the trees are not cut from a hillside, thus permitting the exposed soil to wash away, but the forest is merely thinned; only a part of the mature trees are cut along with the diseased trees and small trees where the stand is too thick. Where a large tree is cut, several seedlings soon take its place. Thus a forest that is continually growing becomes a reality. A crop can be harvested every few years, and still the forests will be better than before. Of course, the forest must also be protected from fire, disease, and grazing animals that might kill off the young trees. A forest will last for thousands of years by such management, and it will gradually become a better forest.

There are some areas best suited for forests that must he replanted, because fires or cutting practices have so denuded the land that nature cannot replant the forests in time to prevent irreparable damage. Reforestation need not be unduly expensive, however, if done wisely. Certainly it will be less expensive than permitting continued erosion and land destruction and then trying to clean up the debris of silt and floods that ravage the lowlands below.

Grasslands can also be handled intelligently. The range and pasture conservationists have a fairly simple formula, too. One of the main principles in their formula is to graze the grasslands properly, and they also recommend that better species of grasses and legumes be planted, and that fertilizers, drainage, irrigation, and other improvement practices be adopted where needed. If a pasture is overgrazed for several years, the production will decrease greatly; furthermore, erosion will rob the land of much of its original productivity. Any pasture or range will produce much more, over a period of years, if only the surplus growth is grazed off. It will gradually improve. And it is still possible to increase production further on most grassland by fertilizing or by planting improved species. Some of the improved species of grasses and legumes will produce three or four times as much forage as the native mixtures of grass and weeds now growing on most pastures and ranges of the United States.

W. M. Myers, of the Bureau of Plant Industry, United States Department of Agriculture, estimated in 1951 that the production from most grasslands in the United States could be at least doubled, and that on some land it could be increased by tenfold or more. He thought that the average production for all grasslands of the nation could be at least tripled.

With the existing technology and a nationwide conservation program of this type, enough could be produced from present farm and grazing land to feed and support at least 250,000,000 people--feed them a 1950 American diet, not a vegetarian diet. The food for these .250,000,000 could probably be produced by the five million farmers and ranchers who now produce most of the food for our 160,000,000.

Such a conservation program would continue to increase the productivity of the land. With the improving technology and proper use of land reserves, it might be possible to produce enough to support five hundred million or a billion people, at an ever increasing standard of living, within the next few centuries. Such a conservation

program would help conserve and improve our water resources. While it would help prevent floods and reduce the huge silt loads of our streams, it would also improve the habitat of wildlife, fresh water fish, and shrimp and oyster beds, and would give us a cleaner and better place in which to live.

No ancient state or nation ever had an effective conservation policy. Many of them tried, but none succeeded in conserving the basis for their civilization. Consideration of this fact prompts the inquiry whether the United States has a national conservation policy. We know, or at least our foremost scientists and conservationists think they know, what is required to conserve our land. Yet it is questionable whether we really have a national conservation policy that is adequate--a policy that we will continue to pursue for as long as necessary.

It will not be enough for us merely to conserve and improve our basic resources for the next generation or two. The farmers who till the soil, the woodsmen who cut the trees, the herdsmen who graze the ranges, the miners who dig ore from the ground, and all others who use and manage our basic resources for the next two hundred or two thousand years must be conservationists. So far as we know, all those who come after us must depend on these resources--what we leave of them--for their food and most of the other necessities of life. The life or death of our government and the prosperity or poverty of our descendants are at stake. We must have a sound national conservation policy. And that policy must become a part of our way of life.

We had no national conservation policy up to the twentieth century. If any policy at all can be identified, it was to encourage exploitation of resources--to get resources into the hands of the people so that production could begin. Since the "great depression" of the 1930's, a national policy seems to have been developing, but it can hardly be defined as a clear-cut policy of conservation. There are encouraging signs that a wise, over-all conservation program may be evolving, but there are also signs that it is by no means assured of success or permanence. In more statesmanlike moments, the Congress of the United States and many state legislatures have passed fundamental conservation laws within recent years which have helped to establish a trend toward conservation and to check the process of unwarranted exploitation and destruction.

On the other hand, many constructive conservation measures have been defeated in the legislative halls by pressure groups of the exploiters, and much of the constructive legislation passed has met with bitter opposition from those who wished to gain quick profits at the expense of future generations. For example, the national parks and monuments were established by the Congress to safeguard forever our outstanding natural wonders and wilderness areas for the enjoyment of all the people. There were about seventeen million visitors in 1950 to these parks, which cover about one-half of 1 per cent of the country. If all of them were turned over to private interests, it would hardly create a ripple in our economic life. Yet hardly a Congress convenes without attempts being made to shrink the boundaries, dam the streams, tap the lakes, flood valleys, open mines, permit grazing, or in other ways obtain the "use" of these public properties for the benefit of a few individuals or communities.

The national forests, which enclose large blocks of territory totaling about 180,000,000 acres, are not solid and continuous forest, but contain areas of grassland, barren land, scrubland, etc. This land yields timber, meat, and wool, and provides

hunting, fishing, camping, and touring. All of these are activities that could be profitable to competent businessmen; hence, small groups or individuals are continually trying to gain control of these public properties. For instance, stockmen graze about 83,000,000 acres of national forest ranges (at reasonable fees), but the Forest Service limits grazing to an amount judged safe by its range experts. Some stockmen resent such limitations, and try to persuade their congressmen to introduce bills to circumvent the system of grazing controls on National Forest lands. The same groups, for the same reasons, try to obstruct the efforts of the Bureau of Land Management to build up the productivity of the 132,000,000 acres of grazing land on the public domain.

The Tennessee Valley Authority was created to develop a regional program of water and soil conservation in one of the eroded and underdeveloped areas of the country. Officials and technicians of the Authority made mistakes in planning and executing this pioneer movement, and a big part of the soil conservation job is still to be done. Although many other nations consider this one of the outstanding achievements in development and conservation of modern times and most of the people living in the Tennessee Valley consider the over-all program of the TVA a great blessing to themselves and their communities, certain public utility corporations do not consider the TVA a blessing, undoubtedly because it competes with them. As a result, utility corporations and other affected people maintain a permanent lobby in Washington to try to whittle away the authority of the TVA. These and other lobbies also fight bitterly to keep Congress from creating similar regional development projects in other sections of the country.

The big stockmen of the West and the public utility corporations are not the only groups that fight conservation projects. Lumbermen, oilmen, and numerous others have waged and are still waging bitter legislative fights which often succeed in defeating specific conservation projects.

These few cases illustrate the opposition that naturally arises to conservation projects in a democracy such as ours. Pressure groups, however, do not oppose all conservation work. They usually advocate conservation for everyone but themselves. But the combined total of their complaints and pressures make it very difficult for the federal and state governments to adopt and adhere to a definite conservation policy. Furthermore, their arguments tend to confuse a majority of the people who are not familiar with the technicalities of specific conservation projects involved. In other words, establishing an effective and continuous conservation policy in a democracy is not an easy thing to do, especially when there can be serious questions concerning what does or does not constitute legitimate conservation.

Yet the gains during the last few decades seem to indicate a trend toward conservation. The question is: Will this trend establish a definite policy--a policy that will eventually result in permanent and effective conservation of all our basic natural resources? It is true that conservation was practically unheard of and seldom thought of in this country fifty years ago, and it is certain that considerable progress has been made, but the fact is that real and permanent conservation has just started.

How do we stand on forest conservation, the first of our natural resources given any national attention? As early as 1891, small areas were set aside as forest reserves; later these areas and other larger areas were established as national forests. Today the

180,000,000 acres in the national forests are administered by the United States Forest Service, where a "sustained yield forestry" policy is practiced. Many state and private foresters are also working to get such a system established on the small acreage of state forests and the vast acreage of private forest land, since about four-fifths of the usable timber of the United States is in private ownership. Farsighted timber companies are practicing sustained yield forestry, but too many are still operating on a cut-and-get-out basis. The Forest Service estimated in 11946 that about 64 per cent of the timber cutting on private lands was poor or destructive, and that only 8 per cent was on a sustained-yield basis. While remarkable progress has been made in forest conservation in the last ten years, we are still using timber faster than we are growing it. We are a long way from a permanent and adequate forest conservation program.

We had no national soil conservation policy and no program until the last two decades. In some areas, particularly in the South, where erosion was most devastating, the state agricultural colleges and other agencies were advocating soil conservation. In the main, however, they were advocating practically the same methods that the Romans used two thousand years ago. Almost invariably, erosion control study in agricultural colleges was assigned to a department of agricultural engineering. This meant that terraces, gully plugs, and other engineering structures were the main conservation measures used.

This situation prevailed throughout most of the country until 1935. It was in the spring of that year that Congress, spurred on partially by the huge dust storms that blanketed the nation, passed its first soil conservation act. The preamble of that act stated "That it is hereby recognized that the wastage of soil and moisture resources on farm, grazing, and forest lands of the Nation, resulting from soil erosion, is a menace to the national welfare and that it is hereby declared to be the policy of Congress to provide permanently for the control and prevention of soil erosion and thereby to preserve natural resources-etc." This was a statesmanlike piece of legislation. It set forth a national policy, and it established the Soil Conservation Service as an organ of the federal government.

The Soil Conservation Service, based on a program of using land within its capabilities and treating land according to its needs, started as a relatively small agency with a few hundred specialists in conservation. By 1954, it had a corps of about 5,000 professional conservationists and another 3,500 subprofessional technicians, most of whom work directly with farmers and ranchers through local soil conservation districts. They make soil surveys to determine land capability, help the farmers and ranchers draw up detailed conservation plans, and assist them install the conservation practices that require special skill. The conservationists advocate the installation of a complete conservation program on each farm or ranch. This seems like a sound approach since the conservationists contend that each farm or ranch on which they help develop conservation plans will be permanently protected--that is, as long as the conservation plan is followed. Furthermore, statistics show that production is nearly always increased on such farms and ranches.

There are two main criticisms, however, of the Soil Conservation Service program. First, conservation plans are not necessarily permanent; new owners or tenants may not wish to follow the conservation plans agreed to by former operators. And secondly, the Soil Conservation Service program is moving too slowly.

In 1951, the chief of the Soil Conservation Service reported that only about 20 per cent of the basic soil and water conservation work had been completed for the country. This report also estimated that about thirty-five years would be required to complete the job of planning conservation programs for all the farms and ranches of the nation. In 1953, the Service judged that the country was still losing the equivalent in productivity of about one-half million acres of good farm land each year. So it seems that we are a long way from having an adequate soil conservation program.
There are many other government agencies, federal, state, and local, engaged in some type of conservation work, and there are numerous private organizations, groups, or individuals working on conservation projects of various types. Many of them are doing excellent work in their special fields, but the combined accomplishments of all these agencies, both public and private, are inadequate. Resources are still being ruined faster than they are being conserved. Most of the conservation groups and individuals are falling far short of their goals, just as are the Forest Service and the Soil Conservation Service.
One other group of government agencies should be given special mention because of their unique character. We refer to the 2,650 soil conservation districts that now include nearly 90 per cent of the nation's farms and ranches. These districts are local units of government organized under state laws. In most states, they are organized by the process of petition and referendum and are governed by an elected board, whose members serve without pay. Up to now, a majority of these districts have served mainly as vehicles through which the Soil Conservation Service carried on its operations, but many districts have recently started aggressive conservation programs of their own. In most states they have full authority to do almost any type of conservation work. The most significant part of their authority is that they may pass laws governing the use of the land-somewhat as cities pass zoning or sanitation laws. Few soil conservation districts have used their legislative authority, but they have it, which is what makes them unique. They are the only governmental units that the authors have been able to find in all the history of mankind, that give a majority of the farmers of an area the specific authority to pass regulations about how all the farmers of the area must or must not use their land.
These 2,650 soil conservation districts have not exercised much of their authority in our national conservation program, but it is entirely possible that they may eventually assume control of most of the land conservation work. If and when they do, their influence is likely to be good or bad, mainly according to how well the landowners and operators (the voters) of a given district are informed about conservation needs and methods.
So much for government policy, group action, and man-made laws and regulations on conservation. Now we shall turn briefly to the really important aspect of our conservation program.
Man's habit of destroying the natural resources from which he lives is as old as civilization. He has developed and acquired this habit through hundreds of generations, and it will not be easy to change his ways. Yet we must change those ways. Such ingrained habits are not changed through man-made laws and regulations. Laws might be passed which prohibit the clean cutting of forests, the plowing up or overgrazing of grasslands on steep slopes, or which regulate the farming practices on

all kinds of land. But such man-made laws can be repealed much easier than they can be passed, and they would be repealed unless an overwhelming majority of the people were in favor of them. Moreover, the enforcement of such laws is not a practical way to achieve true conservation. everybody would profess to practice conservation, while few would actually do it.

Conservation is not something that can be controlled exclusively by legislation. It is largely a way of thinking and a way of living. It is as fundamental as honesty and thrift, and it must be achieved in much the same way. The only way true conservation can be achieved is through universal education toward that goal. The ingrained habits of civilized man must be changed. We have the knowledge and the educational facilities with which to change these habits, but it will be almost as difficult as changing some of the instinctive habits of wild animals. The education must be started early in the life of every individual and continued for as long as he or she is an active participant in our economic and social life.

It is not the future of the United States alone that is involved in this matter of conservation, but the future of the entire human race. Only when most of the people of the world have enough to eat and are able to enjoy the other benefits of modern civilization will the ever present threat of atomic war be removed. A great part of the people of the world will never have the opportunity to enjoy the products of modem society until their natural resources are fully developed and efficiently used. They cannot develop and use these resources on a permanent basis until they institute a sound program of conservation. It will be impossible for many of the overpopulated and backward nations to institute such a program without much technical and educational aid, and possibly some economic aid, from the more fortunate nations of the world.

Since 1945, the United States has been generally recognized as the economic leader of the free world. This leadership is not something to be taken lightly. To retain this position as world leader, this nation must assume some of the responsibilities of leadership, and the most important responsibility that should be assumed is helping the more backward countries raise the standard of living of their people. It is evident that the most effective, and probably the only way we can do so is to help them develop and conserve their natural resources. This is one of the great challenges confronting us. If we fail to meet this challenge effectively, the next generations may witness the decline of civilization over all the world. To meet the world-wide challenge effectively, we, the people of the United States, must first put our own house in order.

BIBLIOGRAPHY

1. Anderson, Wallace I. *Making Land Produce Useful Wildlife.* U.S.DA., *Farmers Bulletin No. 2035.*
2. Dale, Tom. *For Insurance Against Drought--Soil and Water Conservation.* U.S.D.A., *Farmers Bulletin No. 2002.*
3. Duley, F. L. and Russell, J. C. *Stubble Mulch Farming to Hold Soil and Water.* U.S.D.A., *Farmers Bulletin No..1997.*
4. Foster, Albert B., *First Things First.* U.S.S.C.S., *PA--69.*
5. Gee, Chester W. *Taming Runaway Waters.* U.S.D.A., *Information Bulletin No. 16.*
6. Lowdermilk, Walter C. *Conquest of the Land Through 7,000 Years.* U.S.D.A., *Information Bulletin No. 99.*
7. McDonald, Angus. *Early American Conservationists.* U.S.D.A., *Misc. Pub. No. 449.*
8. O'Neal, A. M. and Klingebiel, A. A. *Your Soil--Crumbly or Cloddy?* U.S.D.A., *Leaflet No. 328.*
9. Steele, J. G. *The Measure of Our Land.* U.S.S.C.S., *PA--128.*
10. U.S.D.A. *Our Productive Land. Information Bulletin No. 106.*
11. U.S.D.A. *Outline for Teaching Conservation in High Schools.* U.S.S.C.S., *PA--201.*
12. U.S.D.A. *Technical Skill for Soil and Water Conservation.* U.S.S.C.S., *PA--86.*
13. Bennett, Hugh H., "Land and the Union of South Africa," *Soil Conservation Magazine,* Vol. XI (1945).
14. Briadwood, Robert J. "Mounds in the Plain of Antioch," *University of Chicago Oriental Institute Publications,* Vol. XLVIII.
15. Lowdermilk, Walter C. "Lessons from the Old World to the Americas in Land Use," Smithsonian Report for 1943
16. Russell, Richard J. "Climatic Change Through the Ages," *Yearbook of Agriculture,* 1941.
17. U.S.D.A. "Soils and Men," *Yearbook of Agriculture,* 1938.
18. U.S.D.A. "Climate and Man," *Yearbook of Agriculture,* 1941
19. Beard, Ward P. *Teaching Conservation.* Washington, The American Forestry Association.
20. Beloch, Julius. *Die Bevölkerung der griechisch-romischen Welt.* Leipzig, 1886.
21. Bennett, Hugh H. *Elements of Soil Conservation.* New York, McGraw-Hill, 1947.
22. Boissonnade, Prosper. *Life and Work in Medieval Europe.* New York. Alfred A. Knopf, 1927
23. Brink, Wellington. *Big Hugh.* New York, Macmillan Co., 1951.
24. Carter, Vernon G. *Man on the Landscape.* Washington, National Wildlife Federation, 1950.
25. Dawson, Christopher. *Enquiries into Religion and Culture.* New York, Sheed

and Ward, 1933.
26. Durant, Will. *The Story of Civilization.* 5 vols. New York, Simon and Schuster, 1942-53
27. Elliott, Charles N. *Conservation of American Resources.* Atlanta, Turner E. Smith Co., 1951.
28. Evans, Arthur. *The Palace of Minos.* 4 vols. London, The Macmillan Co., 1921.
29. Frank, Bernard. *Our National Forests.* Norman, University of Oklahoma Press, 1955.
30. Frank, Bernard and Netboy, Anthony. *Water, Land and People.* New York, Alfred A. Knopf, 1950.
31. Gibbon, Edward. *The Decline and Fall of the Roman Empire.* 3 vols. New York, The Modern Library, 1932.
32. Glotz, Gustave. *Ancient Greece at Work.* New York, Alfred A. Knopf, 1930
33. Graham, Edward H. *The Land and Wildlife.* New York, Oxford University Press, 1947
34. Hammerton, J. A. (ed.). *Wonders of the Past.* 2 vols. New York, G. P. Putnam's Sons, 1923.
35. Howard, Sir Albert. *The Soil and Health*. New York. Devin-Adair Co., 1947.
36. Howard, Albert and Howard, G. L. C. *The Development of Indian Agriculture. London,* Oxford University Press, 1929.
37. Hoyt, William G. and Langbein, Walter B. *Floods.* Princeton University Press, 1955
38. Jacks, G. V. and Whyte, R. O. *Vanishing Lands.* New York. Doubleday, Doran and Co., 1939
39. Johnson, Vance. *Heaven's Tableland.* New York, Farrar, Strauss and Co., 1947
40. Kellogg, Charles E. *The Soils that Support Us.* New York, The Macmillan Co., 1941.
41. Lord, Russell and Kate. *Forever the Land.* New York, Harper and Brothers, 1950.
42. Louis, Paul. *Ancient Rome at Work.* New York, Alfred A. Knopf, 1927
43. Lowdermilk, Walter C. *Palestine, Land of Promise.* New York, Harper and Brothers, 1944.
44. McConkey, O. M. *Conservation in Canada.* Toronto, J. M. Dent and Sons, 1952.
45. Mickey, Carl B. *Man and the Soil.* Chicago, International Harvester Co., 1945
46. National Education Association. *Large Was Our Bounty.* Washington, 1948 Yearbook, Association for Supervision and Curriculum Development.
47. Osborn, Fairfield. *Our Plundered Planet.* Boston, Little, Brown and Co., 1948.
48. Osborn, Fairfield. *The Limits of the Earth.* Boston, Little, Brown and Co., 1953ghhhhhhhgghhhhh
49. Picton, Lionel J. *Nutrition and the Soil.* New York, Devin-Adair Co., 1949.
50. Prentice, E. Parmalee. *Hunger and History.* New York, Harper and Brothers, 1939
51. Sears, Paul B. *This Is Our World.* Norman, University of Oklahoma Press,

1947.
52. Shepard, Ward. *Food or Famine: The Challenge of Erosion.* New York, The Macmillan Co., 1945.
53. Smith, Guy-Harold (ed.). *Conservation of Natural Resources.* New York, John Wiley and Sons, 1950.

HB-1617
Submitted on: 2/11/2026 7:27:08 AM
Testimony for EEP on 2/12/2026 10:20:00 AM

Submitted By	Organization	Testifier Position	Testify
Fredrick Sands	Individual	Support	Written Testimony Only

Comments:

Aloha Chair Lowen and Vice Chair Perruso, Committee on Energy & Environmental Protection, and Chair Chun and Vice Chair Kusch, Committee on Agriculture & Food Systems,

I strongly support this bill because it reduces climate pollution and increases Hawai‘i’s energy independence while financially helping vulnerable kama‘aina families.

The bill places a gradually rising carbon fee on fossil fuels, incentivizing businesses and individuals to use less fossil fuels, the emissions from which are warming the Earth and creating climate havoc in Hawai‘i and globally.

The policy is budget neutral. The carbon fee revenues are used to fund a climate rebate that is distributed to Hawai‘i tax filers. The climate rebate makes the bill progressive and protects vulnerable lower-income families.

The bill is simple to administer because it relies on existing mechanisms to collect the carbon fee and distribute the climate rebates.

Hawai‘i must take a multi-pronged approach to reduce carbon emissions and lessen our dependence on fossil fuels that are subject to the price volatility of the global market while financially helping our kama‘aina make the transition. This bill helps achieve those goals efficiently and equitably, and works well with other policy approaches.

Mahalo! Fredrick H Sands MD

HB-1617
Submitted on: 2/11/2026 7:40:06 AM
Testimony for EEP on 2/12/2026 10:20:00 AM

Submitted By	Organization	Testifier Position	Testify
Helen Cox	Individual	Support	Written Testimony Only

Comments:

Aloha Chair Lowen and Vice Chair Perruso, Committee on Energy & Environmental Protection, and Chair Chun and Vice Chair Kusch, Committee on Agriculture & Food Systems,

I strongly support HB1617 because it addresses a major cause of our climate crisis and increases Hawai‘i’s energy independence while financially helping local families.

There is no doubt that fossil fuel emissions are creating unwanted and dangerous climate impacts in Hawaii and throughout the world. The situation will only worsen if we do not transition to clean energy. This bill places a gradually rising carbon fee on fossil fuels, incentivizing businesses and individuals to use less fossil fuels.

The policy is budget neutral and simple to administer since it relies on existing mechanisms to collect the fee and distribute the proceeds. The carbon fee revenues are used to fund a climate rebate that is distributed to Hawai‘i tax filers. The climate rebates make the bill progressive and protects vulnerable lower-income families.

There is no silver bullet to address the climate crisis, but this bill is an effective and efficient way to reduce carbon emission. This reduction has the added benefit of lessening our dependence on fossil fuels that are subject to the price volatility of the global market. And importantly, the bill will help our residents make the transition to clean energy.

Please pass HB1617. Mahalo!

Helen Cox, Kalaheo, Kauai

HB-1617
Submitted on: 2/11/2026 9:13:42 AM
Testimony for EEP on 2/12/2026 10:20:00 AM

Submitted By	Organization	Testifier Position	Testify
Nanea Lo	Individual	Support	Written Testimony Only

Comments:

Hello Chair Lowen and Vice Chair Perruso, Committee on Energy & Environmental Protection, and Chair Chun and Vice Chair Kusch, Committee on Agriculture & Food Systems,

I strongly support this bill because it reduces climate pollution and increases Hawai‘i’s energy independence while financially helping vulnerable kama‘aina families.

The bill places a gradually rising carbon fee on fossil fuels, incentivizing businesses and individuals to use less fossil fuels, the emissions from which are warming the Earth and creating climate havoc in Hawai‘i and globally.

The policy is budget neutral. The carbon fee revenues are used to fund a climate rebate that is distributed to Hawai‘i tax filers. The climate rebate makes the bill progressive and protects vulnerable lower-income families.

The bill is simple to administer because it relies on existing mechanisms to collect the carbon fee and distribute the climate rebates.

Hawai‘i must take a multi-pronged approach to reduce carbon emissions and lessen our dependence on fossil fuels that are subject to the price volatility of the global market while financially helping our kama‘aina make the transition. This bill helps achieve those goals efficiently and equitably, and works well with other policy approaches.

me ke aloha ‘āina,

Nanea Lo, 96826

Sierra Club of Hawai‘i Member

Hawai‘i Workers Center Board Member

Honolulu Tenants Union Member

350 Hawai‘i Member

Carbon Cashback Hawai‘i Member

Hawai‘i Tax Fairness Coalition Member

HB-1617
Submitted on: 2/11/2026 9:33:52 AM
Testimony for EEP on 2/12/2026 10:20:00 AM

Submitted By	Organization	Testifier Position	Testify
Susan Browne	Individual	Support	Written Testimony Only

Comments:

I support this Carbon Cashback bill as it will reduce fossil fuel imports and climate pollution and make Hawaii more energy independent.

HB-1617
Submitted on: 2/11/2026 5:34:08 PM
Testimony for EEP on 2/12/2026 10:20:00 AM

LATE

Submitted By	Organization	Testifier Position	Testify
Nate Hix	Individual	Support	Written Testimony Only

Comments:

We must do everything we can to limit carbon emissions. This is the most cost effective way to mitigate our carbon emissions. It also financially helps low-income families. Please pass this bill.

HB-1617
Submitted on: 2/11/2026 10:27:22 PM
Testimony for EEP on 2/12/2026 10:20:00 AM

LATE

Submitted By	Organization	Testifier Position	Testify
Beth Anderson	Individual	Support	Written Testimony Only

Comments:

I stongly support HB 1617 because we need to accelerate reduction of carbon emmissions from fossil fuels. Climate change is accelerating and damaging our coral reefs, native species, crop production, wildfires and major losses to the economy.

I support any legislation that supports green energy alternatives to fossil fuel use and incentives to decrease fossil fuel use.

Thank you for introducing Bill HB 1617. You have my full support.

HOUSE OF REPRESENTATIVES
THE THIRTY-THIRD LEGISLATURE
REGULAR SESSION OF 2026

COMMITTEE ON ENERGY & ENVIRONMENTAL PROTECTION
Rep. Nicole E. Lowen, Chair
Rep. Amy A. Perruso, Vice Chair

Rep. Cory M. Chun
Rep. Kirstin Kahaloa
Rep. Matthias Kusch
Rep. Sean Quinlan
Rep. Lauren Matsumoto

COMMITTEE ON AGRICULTURE & FOOD SYSTEMS
Rep. Cory M. Chun, Chair
Rep. Matthias Kusch, Vice Chair

Rep. Kirstin Kahaloa
Rep. Nicole E. Lowen
Rep. Amy A. Perruso
Rep. Sean Quinlan
Rep. Lauren Matsumoto

HEARING

DATE: February 12, 2026
TIME: 10:20 PM
PLACE: VIA VIDEOCONFERENCE
Conference Room 325

Public commentor: Ted Metrose (independent) Opposed

HB1617 (SB2332) – Carbon Tax on liquid and gaseous fossil fuels including aviation fuels. Allocates proceeds to special funds and the general fund to compensate taxpayers with tax credits.

Synopsis/Highlights

Gradually [?] increases the Environmental Response, Energy, Carbon Emissions, and Food Security tax rates and establishes a refundable carbon cashback tax credit to offset increases for most taxpayers. Establishes the Carbon Emissions Tax and Dividend Special Fund ($1,000,000/yr). Reestablishes the Agricultural Development and Food Security Special Fund. Requires reports to the Legislature. Appropriates funds.

1. To account for the true cost of carbon emissions, HB1617 raises the Emergency Response, Energy and Food Security Tax (aka barrel tax) on fossil fuels (specified in HRS 243-3.5) from $1.05/barrel to $5.25/bbl in the first year and continues escalate on a straight-line basis to $43.05 in year 10 (2035) and then adds an additional $ 1/bbl every year thereafter.
2. Similarly, the ER, E, & FS tax on normally gaseous fuels would be increased from the current rate of $0.19/MMBTU to $0.79/MMBTU in the first year and would continue to escalate on a straight-line basis to $6.09 in year 10 (2035) and then add an additional $0.15/ MMBTU every year thereafter.

3. Tax proceeds from the carbon-barrel tax on aviation fuel will and must be directed to the airport fund.
4. After distributing the proceeds from the carbon tax to the special funds, the balance of the carbon tax is directed into general fund, from which the carbon tax credit may be issued or claimed by taxpayers on a prorated share basis by dividing the general fund proceeds by 1,440,000 (the population baseline).
5. Proceeds from carbon tax remaining in the general funds which have not been issued or claimed as a cashback tax credit would be directed to fund med-QUEST.

Simplified Projections and Analysis

Provided below is a projection of the impacts and allocation of the proposed carbon tax which is based on DOTAX historic fuel taxes to establish fossil fuel baseline.

Baseline/Premise

While State GHG inventories and the carbon pricing assessment show more fossil fuels are being consumed, this analysis used DOTAX data as the basis for the baseline because it reflects the actual amount of fossil fuel that is or will be subject to the new carbon tax. As noted previously, much of the jet fuel that is sold in the State is not subject to taxation or manage to escape it. In 2025 the airlines in their testimony in support of tax credits indicated that approximately 600 million gallons of commercial jet fuel is sold in the State. As indicated below over a recent 3-year period, less than half of that amount (284 million gallons) has been taxed according to DOTAX's annual reports.

Fossil Fuels which would be subject to Carbon Tax	3 Yr Ave (2022-2024)	
	BBLS	**MM Gals**
ERT - Petroleum Products	24,689,150	1,037
Aviation Fuel (taxed)	6,761,233	284
Pet Products plus Aviation	31,450,382	1,321

From published DOTAX reports available on DOTAX's website. Excerpts are attached.

Note: Although aviation fuel is subject to a small $0.01/ gal fuel tax as indicated above, aviation fuel is currently exempt from the current ($1.05/ barrel) Emergency Response Tax (ERT) but would along with other fossil fuels be subject to the proposed escalating carbon tax, upon elimination of the existing exemption in HRS 243-3.5 as proposed by HB1617 (SB2332).

Impact: First Year and Beyond

As shown below, assuming no material reduction in fossil fuel consumption in 2025 and 2026, the new carbon barrel tax on just liquid fuels will jump from $25.9 million dollars per year to approximately $ 165.1 million per year in its first year of imposition.

Fossil Fuels which would be subject to Carbon Tax	**BBLS**	Current **$1.05 BBL/ tax**	Proposed 1st Yr **$5.25 BBL/ tax**
ERT - Petroleum Products	24,689,150	$ 25,923,607	$ 129,618,036
Aviation Fuel (taxed)	6,761,233	0.0	$ 35,496,471
Pet Products plus Aviation	31,450,382	$ 25,923,607	$ 165,114,507

And again, that is just the first year, with increases in the carbon tax rate of a similar magnitude preprogramed for the next 9 years. If no reductions in fossil fuels occur, by 2035 the carbon tax ($1.35 billion) could represent an additional tax burden of 16% of the State current total tax burden ($11.6 billion dollars in 2024). Even if the carbon tax is very effective and reduces the consumption of fossil fuels by 5% per year as projected below, in 2035 the carbon tax would be $745 million dollars, an increase in the overall tax burden of 6.4%.

Provided below are a series of 4 charts, which shows the impact of the escalation of the carbon tax along with the allocation of the carbon-barrel tax to special funds and the general fund based on the amount of fossil fuels consumed in the State.

Like the tables above, the graphs below do not account for the carbon tax on gaseous fossil fuels, mostly from synthetic natural gas (SNG) and LPG sold by Hawaii Gas because it represents such a small percentage (<4%) and does not materially alter the evaluation of the carbon tax. (See historic basis and amount of barrel tax reported by DOTAX, excerpted below.) Also ignored is the special dedicated allocation of the carbon-barrel tax for small boats, because it too is insignificant, not required by federal regulations and takes too many words to explain.

The graphs below show how much money will be collected from the carbon tax and directed to various special funds and how much will be available as a tax credit - under two assumptions:

- no reduction in fossil fuels and
- a 5% annual reduction in fossil fuels (which means the carbon tax worked perfectly in 20 years).

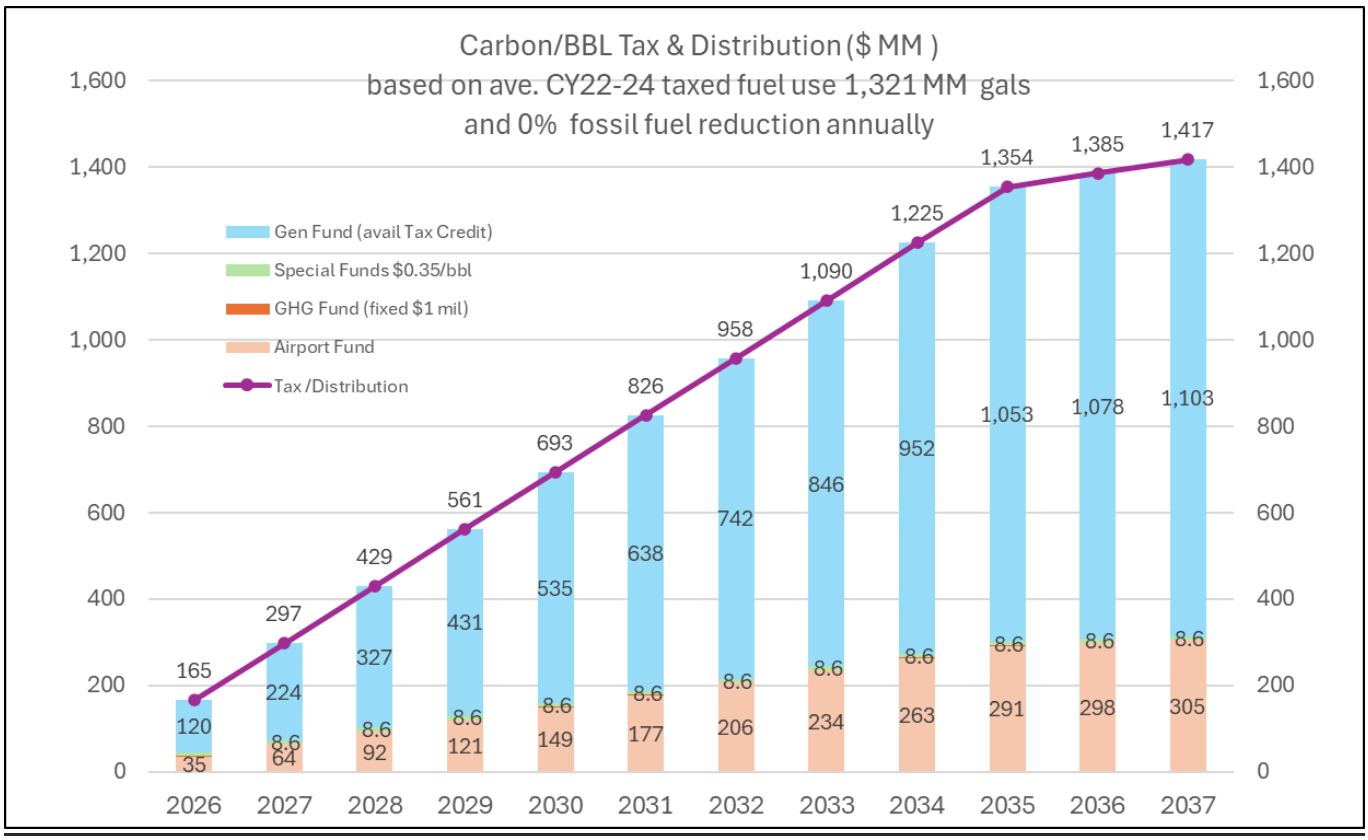
The estimated value of the carbon cashback, drawn as a tax credit from the general fund is also presented. There is no relief or carbon tax credit allowed for businesses under either scenario.

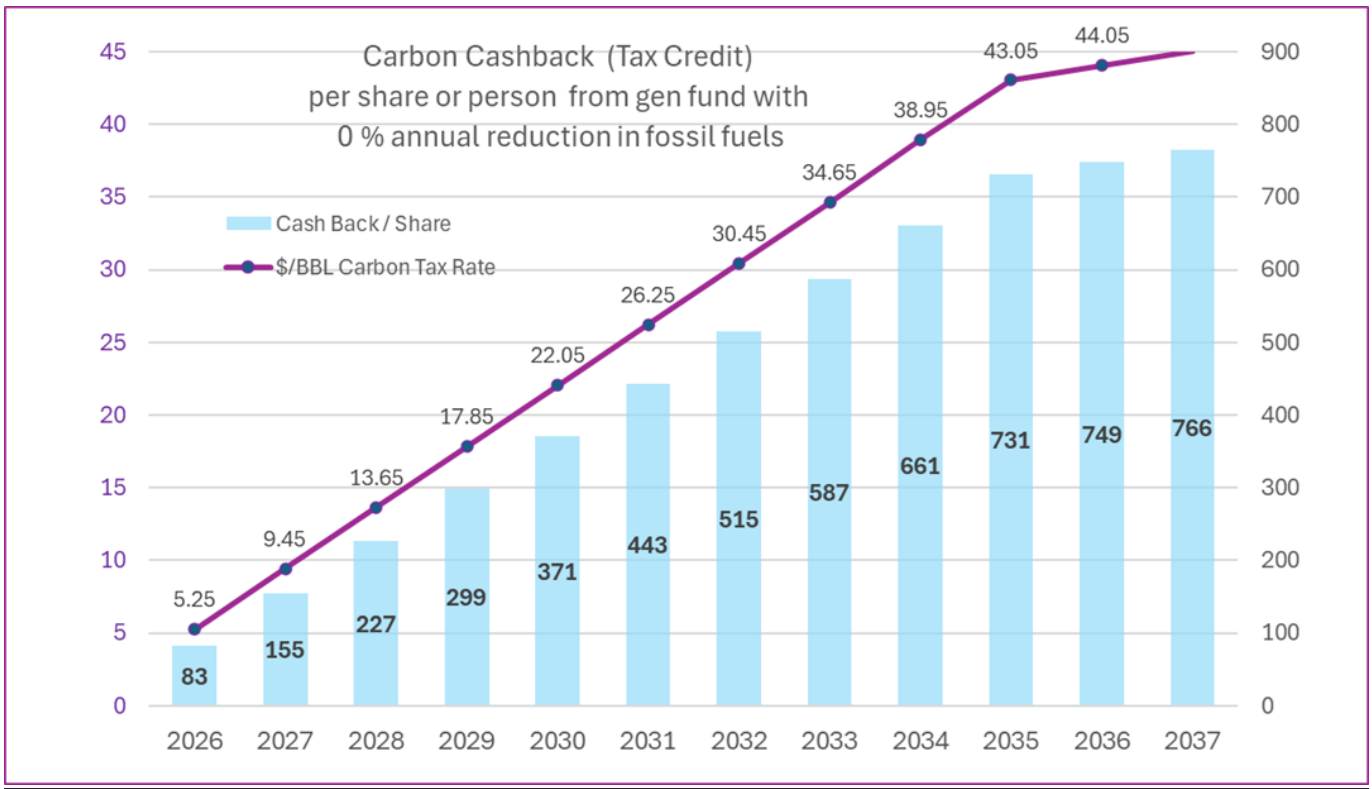
Most of the special funds that are shown below are based on an aggregated total of $0.35 per barrel, based on summing "[X] cents of the tax on each barrel ". The airport fund is somewhat unique, because it is self-funded and the carbon dividend fund is fixed at $ 1,000,000 per year as proposed.

Because the special funds including the airport are based on the number of barrels of fossil fuel consumed, most of the escalating carbon tax will be directed to the general fund (instead of the special funds) and may be returned/issued to taxpayers as a carbon cashback credit. Special funds which are dependent upon the amount taxable fossil fuel sold in the State will see their funds shrink as the amount of fossil fuel declines (5% per year in this simulation).

As depicted below hundreds of millions of dollars and potentially more than $1 billion dollars of addition costs (in the form of new taxes) will be imposed on the economy annually, in an attempt to get the public to recognize the true cost of fossil fuels and moderate its consumption accordingly. Then 75% - 80% of the proceeds from the tax (nearly all of carbon tax, except that portion which must be dedicated to the airport fund) would be returned to taxpayers (but not businesses) , so that residents and families can afford to pay higher/escalating prices for everything (especially electricity and traditional fossil fuels).

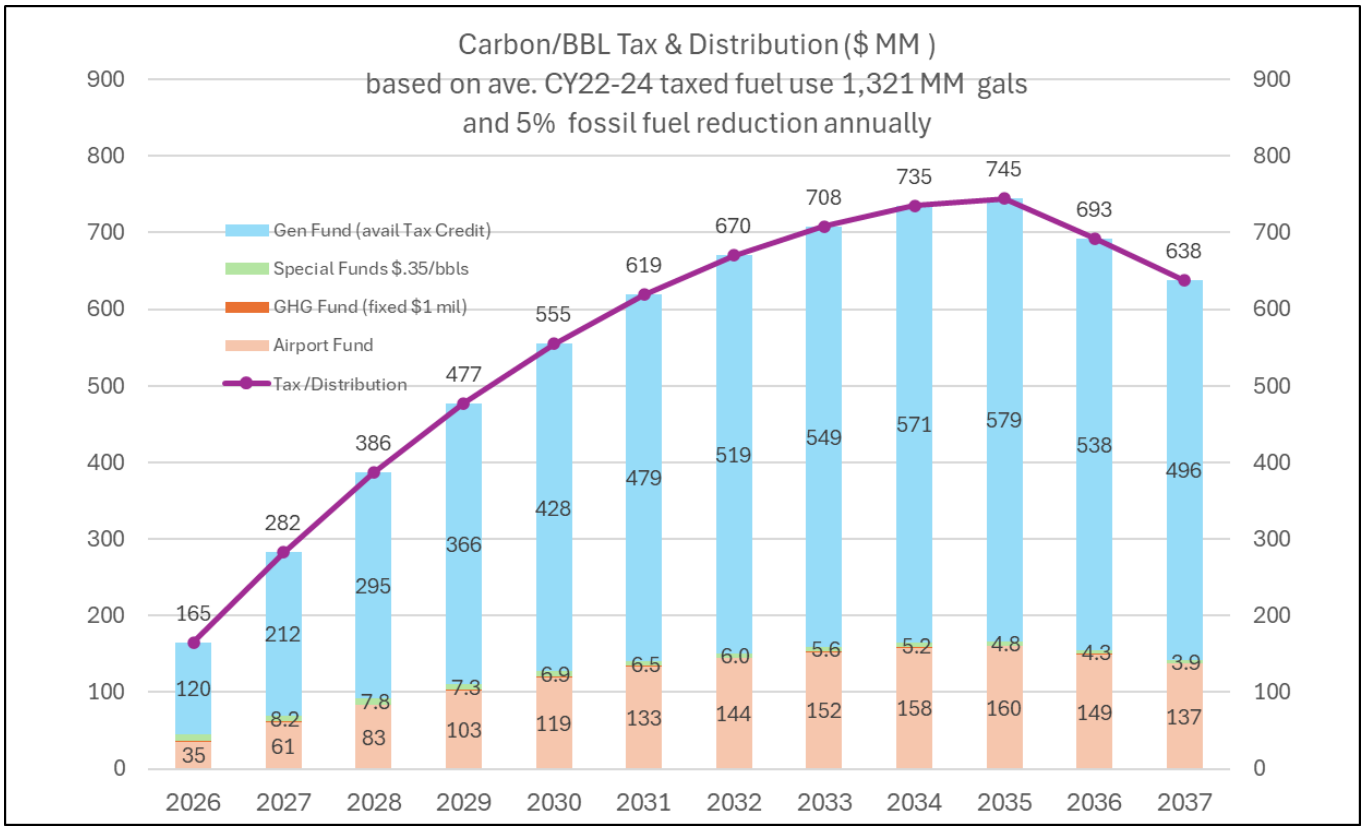
0% Reduction in Fossil Fuel Reduction assumed

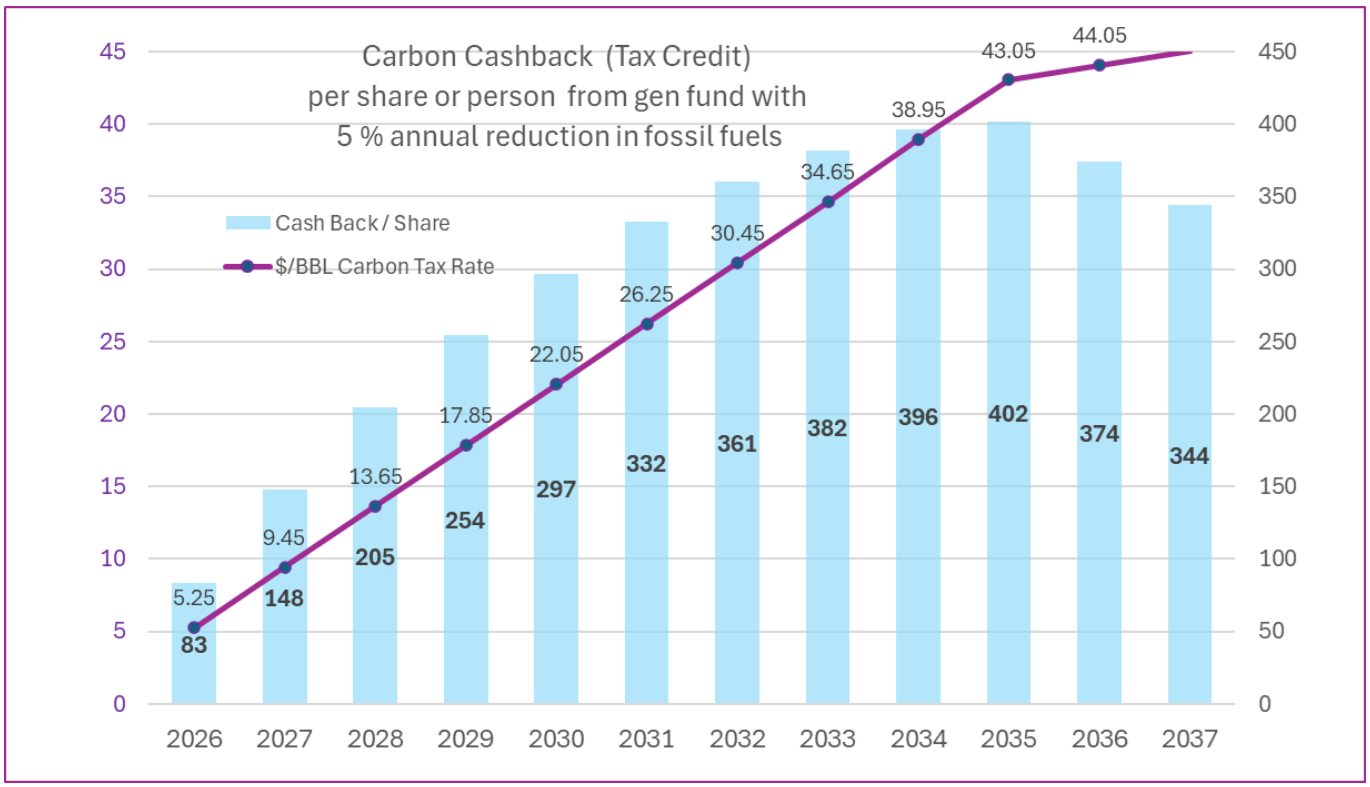




Cash Back Share = Gen Fund Allocation/ 1,440,000 (baseline population) as specified by SB2332

5% Annual Reduction in Fossil Fuels (5% of baseline)





Cash Back Share = Gen Fund Allocation/ 1,440,000 (baseline population) as specified by SB2332

As shown above, assuming the carbon tax is successful and (ideally) reduces the consumption of fossil fuels by 45% on the presumed 5% per year schedule, in 2035 the carbon tax (alone) will impose a direct tax burden of at least $745 million dollars on fossil fuels (not accounting for any ripple effects). To partially offset the "true" cost of fossil fuels (including the carbon tax), the barrel tax collected and remitted by fuel distributors would make an additional $579 million dollars available in the general fund for cashback tax credits in 2035. That would translate to approximately $402 per person (taxpayer or dependent) in 2035.

Continuing with the optimistic reduction scenario above and assuming, as intended by HB1617, that the carbon tax can be collected on just the conventional aviation fuel that will still be consumed during transpacific flights, the estimated $160 million-dollar tax on conventional jet fuel, (in 2035) will significantly raise the cost of flying. However, unlike other fuels, none of proceeds from the ($1.03/gal) carbon tax on conventional jet fuel can/will be returned to the general fund and passed on to taxpayers to offset the cost of an airline ticket or other goods impacted by the carbon tax.

While taxpayers will not benefit directly from a carbon tax on conventional jet fuel, there is still a positive impact. The State may not have to pull from the general funds or issue bonds to make much needed repairs and upgrades to the airports, if the emergency response tax (ERT) and the carbon tax were applied to jet fuel. In February of 2025 the DOT reported successfully raising $849 MM in bonds for airport upgrades and repairs. Clearly the State needs the tax revenue. Specific purpose borrowing for the airports may not be as necessary if revenue can be generated by eliminating the exemptions for aviation fuel and by applying the barrel tax and other taxes. There may be considerable merit to dropping exemptions and raising the $0.01/gallon tax on jet fuel, even as a standalone proposition.

Summary and Concerns:

The merits of the carbon tax are questionable at best. The sophisticated models used for UHERO's carbon assessment projected a moderate economic impact (downturn). However there is a risk that the rather dramatic and on-going increases in fuel prices caused by imposition of the carbon tax which increases - more than 8X (from $5.35/bbl to $43.05/bbl) in just 9 years, will be seen as broadly inflationary and either lead to higher prices and/or create a larger contraction than may have been anticipated/modeled. To those who are affected, the carbon tax cannot be reasonably characterized as gradual. Inequitable distribution of the cashback dividend to taxpayers (but not business) will create unforeseen inflationary pressures.

Additionally, the impact of the tax hike on fossil fuels will be immediate and felt daily, but the relief from the cashback provision will be delayed until tax credits are distributed, once a year at tax time, even if the tax credits are designated as refundable and made almost automatic.

In the optimistic straight-line simulation of fossil fuel reductions, an individual share of the cashback tax credit peaks in 2035 at $402 and declines to $374 the following year, when rate of increase of the carbon tax slows. The tax credit will continue to decline even as the carbon tax continues to rise (albeit at a slower rate of $1/bbl per year.) There will be no carbon tax cashback for taxpayers once fossil fuels are eliminated, but taxpayers are certain to feel like they need some form of relief because prices will be higher not just because renewable fuels are more expensive, but also because the cost of just about everything in Hawaii is likely to be inflated.

While individual taxpayers will receive tax credits from the carbon tax, there is no similar allowance or provisions in HB1617 for business. Businesses will see the full impact of the escalating carbon tax and will have to pass those costs along. Companies and businesses which consume more electricity or fossil fuel, will be more severe than those that use less. Companies like Lex Brodies for example may not be severely impacted, but farmers and grocery stores who consume more fuel and electricity on a relative basis must either pass along the extra energy costs to customers or shrink their business/carbon footprint. Unlike individuals, as currently constructed businesses are not entitled to and cannot claim a share of the carbon cashback dividend. Because of the State's heavy dependence on fossil fuels, not just for electricity but also for transportation (moving goods and people to Hawaii) the rapidly escalating carbon tax will likely lead to an inflation rate that will be unique to Hawaii, further exasperating the affordability challenge.

Similarly, the public sector will be significantly impacted and with no means of collecting a share of the carbon cashback dividend, the State and counties will be forced to pass the extra carbon tax on to the public by increasing either fees or taxes. Fuels costs for all forms of public transportation will increase approximately 26% year as will the cost to cool public schools and other State owned or leased facilities. Whereas there are numerous references to the public good, UHERO's 2021 Carbon Pricing Assessment had relatively little (virtual no) discussion of the cost on the public sector, which suggests the impact of the tax and inflationary effects may be under appreciated. Whereas the federal government is exempt from the carbon-barrel tax, State and counties are not. Consequently, in addition to paying more for renewable fuels, State and county budgets will also be burdened by the carbon tax on fossil fuels, with little recourse.

Special funds are even more definitely impacted by the escalating carbon tax. As depicted in the graph above, when the rate of increase of the carbon tax slows (in 2036) and the amount of fossil fuels being consumed in the State declines, as intended, the special funding drops as well.

Eventually, if successful (in 2045?) there will be no money for carbon cashback credits and no money for special funds from the barrel tax. Most special funds (other than the airport fund) will be even more quickly and dramatically impacted (than the general fund) because special funds are a function of only the number of barrels of fossil fuel consumed - not the total revenues collected from the carbon tax on fossil fuels. Special funds, in year 1, of $8.6 million drop to $8.2 million in year 2 (2027) based on the presumption that the amount of fossil fuel consumed will decline by 5% percent per year. By 2035, the $0.35/bbl tax allocation for select special funds will only receive $4.8 million dollars per year from the barrel-carbon tax. Obviously with the phase out of fossil fuels, the funding of special programs through the barrel tax is not secure.

Smaller Fixes for the Carbon Tax

Although the carbon tax had some theoretical potential, as written I oppose this bill because the programmatic escalation of the carbon tax (roughly 26% per year) is too extreme and is likely to raise costs far beyond the fossil fuels for which it is targeted. If legislators are still inclined to advance this bill (without more structural reforms), please consider the following smaller improvements (tweaks).

1. Subject to the recommendations of DOTAX at least 3 full-time employees should be reserved and appropriated for oversight, auditing of distributors and required reporting of the carbon tax. Distribution of the proceeds from carbon-barrel tax is just as critical and perhaps even more challenging.

2. Prohibit the carbon tax from being embedded in the unit price of fuels sold/distributed (including Hawaii Gas, who just last year has already made the mistake of embedding the ER, E, & FS tax into its revenue tax making it virtually untraceable. Particularly because the tax will be so large and will be collected through so few distributors, the carbon-barrel tax must be as transparent possible so that it may be readily audited and tracked back into the State's special and general funds. Additionally auditing and controls should be imposed to administer and provide State oversight of the massive carbon tax, which in 8 years would reach $34.65/barrel, more than 50% of the current price/cost of crude oil today.

3. Delete proposed paragraph 243-3.5(e) pertaining to coal - it is no longer necessary

4. Delete paragraph (f) the dedication of any excesses to med-quest an unnecessary measure to make the carbon tax truly progressive. Suggest just leave any excesses in the general fund. You don't want to make funding for such an important function dependent upon an unrelated barrel tax, which is likely to go up and then down, causing a shortfall (or a distorted windfall that would have to eventually be redirected). It would largely depend on whether cash back tax credits are fully and/or automatically refundable.
There is no real justification for directing unclaimed tax credits from a tax on fossil fuels to Med-Quest. This is not a health care bill. The effects are sweeping and impacts all sectors so the general fund makes more sense. If there has to be designated receptor of the unclaimed tax credits, then (consistent with the primary intent of this bill) it should go towards the infrastructure needed to address the effects of climate change especially rising ocean waters.

5. Wholesale changes to the allocation approach may be needed to account for a carbon tax which rises dramatically as the tax base declines. As presented above, the allocation of proceeds to the special funds has its shortcomings because the money generated by the carbon-barrel tax will be in constant decline as fossil fuels are phased out. Either a flat dollar value as had been proposed for the carbon dividend fund or perhaps start with a flat rate and specify an allowable increase of 2.5% for nearly all the special funds, other than the airports fund.

6. Consider eliminating or reformatting the special allocation of $ 1.05 /gal on gasoline or distillate fuel distributed to small boats entirely to the boating special fund. It allows no consideration for the funding of emergency response to spills from small boats. The allocation for the small boat fund reads as if only the current barrel tax rate applies to fuel sold for use on small boats and not the new carbon-barrel tax. It is easy to confuse the allocation with the tax rate. Unless there is a compelling reason, like a federal requirement, the allocation of the proceeds from the tax for the special boating fund should either be fixed or of the same general form as other special funds.

DOTAX Annual Tuel Tax Reports used to establish the fossil fuel baseline (2022-2024)

Calendar Year **2024**	gals/bbls/MMBTU	State Tax (Only)
Gasoline	421,543,837	67,403,071.71
Diesel Oil (off-highway)	175,119,451	1,751,194.51
Diesel Oil (highway)	43,769,449	7,143,543.52
Liquefied Petroleum Gas (highway)	(6,923)	(355.45)
Small Boats (gasoline)	1,272,941	203,670.56
Small Boats (diesel oil)	(2,758,526)	(27,585.26)
Aviation Fuel	249,738,049	2,527,699.41
Other Fuel 1/	10,562,209	235,714.86
SUB-TOTAL	**899,240,488**	**79,236,953.86**
ERT - Petroleum Products (barrel) 2/	24,624,198	25,855,407.90
ERT - Fossil Fuels (MMBtu) 2/	5,823,582	1,106,480.58
SUB-TOTAL		**26,961,888.48**
TOTAL		**106,198,842.34**

Calendar Year **2023**	gals/bbls/MMBTU	State Tax (Only)
Gasoline	426,682,290	68,121,171.13
Diesel Oil (off-highway)	164,082,427	1,640,824.27
Diesel Oil (highway)	44,969,587	7,195,078.12
Liquefied Petroleum Gas (highway)	1,548	80.52
Small Boats (gasoline)	1,221,714	195,474.24
Small Boats (diesel oil)	2,983,572	29,835.72
Aviation Fuel	294,135,728	2,941,357.28
Other Fuel 1/	29,633,768	624,202.79
SUB-TOTAL	**963,710,634**	**80,748,024.07**
ERT - Petroleum Products (barrel) 2/	24,941,306	26,188,371.29
ERT - Fossil Fuels (MMBtu) 2/	5,833,669	1,108,397.11
SUB-TOTAL		**27,296,768.40**
TOTAL		**108,044,792.47**

Calendar Year **2022**	gals/bbls/MMBTU	State Tax (Only)
SUMMARY		
Gasoline	419,799,356	66,978,921.24
Diesel Oil (off-highway)	156,974,433	1,569,744.33
Diesel Oil (highway)	52,591,379	8,414,637.87
Liquefied Petroleum Gas (highway)	19,920	1,035.80
Small Boats (gasoline)	1,277,852	204,456.32
Small Boats (diesel oil)	4,369,755	43,697.55
Aviation Fuel	308,041,534	3,080,415.34
Other Fuel 1/	27,155,294	573,199.59
SUB-TOTAL	**970,229,523**	**80,866,108.04**
ERT - Petroleum Products (barrel) 2/	24,501,945	25,727,042.19
ERT - Fossil Fuels (MMBtu) 2/	5,833,732	1,108,409.08
SUB-TOTAL		**26,835,451.27**
TOTAL		**107,701,559.31**

*See reverse for detail on Off-Highway Use Refunds.

Note: Aviation fuel is exempt from the ERT for Petroleum Products. ERT includes utility fuel oil+.