Transactions

of the

TEXAS ACADEMY OF SCIENCE

1938-1939

VOLUME XXIII

Houston, Texas
Published by the Academy
1940

TEXAS ACADEMY OF SCIENCE ORGANIZATION

AFFILIATED WITH
AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

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ACADEMY HANDBOOK

PREFACE

We have tried, with the limited funds available to give representation to as many groups as possible in this Publication. You will note that under the Senior Division there are papers from Sections II, III, and V. We regret, considering the outstanding programs presented, that no papers were submitted from Section IV, so that your Committee had no choice regarding Geology papers. We would have liked to have included one of the three papers submitted from Section I but funds would not permit the addition.

The Collegiate Division is represented here for the first time, as is also the Junior Academy Division. We believe that our senior members will enjoy reading these prize winning papers and will welcome the opportunity to help these high school and college students.

There have been many requests for the rules and regulations governing our Academy, and some criticism that each member on joining did not get a copy. In order to meet this demand we are publishing herein the Academy Handbook in place of publishing several of the eight other papers that have been submitted to us this year.

The policy of the Committee is to publish all the worth while papers submitted that our funds will permit and always to give preference to our Texas members.

Our members will or have received this year, the following publications: The Biological Survey of the East Texas Big Thicket Area—Parks, Cory, et al (to new members); The Vegetation of Texas—Tharp; Game and Fish Research in Texas—Tucker; Proceedings, Vol. XXIII; Transactions (herewith).

Chairman, Publication Committee

October 20, 1940.

FISHES FROM THE BIG BEND REGION OF TEXAS

By Carl L. Hubbs

Although the Big Bend region of Brewster County, Texas, including the Chisos Mountains, is one of the more distinct faunal districts of the state, almost nothing has been published on the fishes which inhabit the region. The area is discussed, collecting localities listed and mapped, and the bird fauna treated in detail, by Van Tyne and Sutton (1937). Muller (1937) briefly discussed the physiography, climate and flora of the Chisos Mountains, and listed the plants. Sperry (1938) gave a glossary of place names in the proposed Big Bend National Park, briefly treated the phytogeography of the region, and also listed the plants. Further information on the region is given in the papers by Udden (1907) and Palmer (1928). The Chisos Mountains Quadrangle, by Stiles, was published in the U. S. Geological Survey in 1903.

Except in the Río Grande, the waters of the region are limited to springs, and to creeks which only locally or ephemerally flow over their stream beds. This is especially true of Maravillas and Tornillo creeks. The third main watercourse, Terlingua Creek, is somewhat less subject to desiccation, but it, too, does not always flow to its mouth.

During most of the year, as I am informed by Prof. Leo T. Murray, the run-offs from these springs form small streams which rapidly decrease in volume and disappear altogether a few miles from their sources. But after heavy rains, torrential floods reach to the Río Grande for a short time. Generally, however, such flood waters recede so rapidly that fish can not utilize them to reach the permanent headwaters.

In the opinion of Dr. Josselyn Van Tyne, who has explored the region for birds, it is improbable that the higher slopes of the Chisos Mountains support any fish life, because water is extremely limited there except when floods gouge out the canyons. Prof. Murray suggests that there are some high-elevation springs which would probably hold a small fish fauna, but are barren of fish life because of falls in the flood-water outlets.

The few collections made in the Big Bend region, however, indicate that its fish fauna is moderately well developed, and includes some Mexican species which are otherwise unknown or very rare in the United States. *Notropis lutrensis blairi*, new subspecies, and *Gambusia gaigei* Hubbs are known only from this region.

The distinctiveness of the fish fauna of the region should be considered in plans for the establishment and management of the Big Bend National Park. One argument for setting up the Park is the opportunity of protecting and preserving here certain fish species which might otherwise become exterminated, at least in the limits of the United States. When the Park is established, the policy should be formed and adhered to, of not introducing any exotic species, such as bass and sunfish, for they might readily consume the peculiar native fishes. There is not enough water in the region to support any considerable amount of sport fishing, even if sport should be ranked above preservation in Park policy. For many years the tendency in the National Parks was to extend full protection to animal life above the water surface, but to regard the aquatic fauna as designed for sport alone (Madsen, 1937). Naturalists will hope, in line with present indications, that the future policy of the Park Service will give due consideration to the preservation of aquatic as well as terrestrial life.

The fish life of the Big Bend region may have been affected by the pollution of the Río Grande, since much of the fauna of the ephemeral creeks of the region is derived directly from the river. Prof. Murray writes that "poisonous run-off from mercury and silver mines in the region are reported to have killed vast numbers of fish in the Río Grande from Presidio to Glenn Spring, some years ago."

Fish specimens have been collected in the creeks and springs of the Big Bend region by several naturalists, at the following stations (for locations, see map and locality list given by Van Tyne and Sutton, 1937):

Station 1. Glenn Spring, on the eastern border of the Chisos Mountains, at an elevation of 2,600 feet. The water is not noticeably charged with alkali. There is a dense growth of *Chara* on a very soft bottom. A collection was made here by F. M. Gaige on June 20, 1928, when the small spring-fed cattle tank was partially drained for irrigation.

Station 2. Spring along the Río Grande at Boquillas, at an elevation of 1,850 feet. This spring forms small streams a few inches deep, without obvious current, in a cattail marsh. Fishes were collected here with forceps by F. M. Gaige, on August 3, 1928.

Station 3. Garden Springs (also known as Monument Spring), to one side of the generally dry bed of Peña Colorada Creek, of the Maravillas Creek drainage, 12 or 13 miles south and slightly west of Marathon, at an elevation of 3,700 feet. The seining at this locality was done on April 16, 1937, by Josselyn Van Tyne and W. Frank Blair.

Station 3*a*. Same locality. A second collection was made in Garden Springs by Leo T. Murray and party of Baylor University Museum, on July 19, 1938.

Station 4. Peña Colorada Creek, 4 miles southwest of Marathon, on the Combs Ranch, at the outlet end of the Marathon Basin, at an elevation of about 4,500 feet. This cool and clearish, but easily roiled, creek, 3 to 20 feet wide, contains some vegetation (*Chara* and a fine-leafed *Potamogeton*). It flows between clay banks in a desert flat, over mud and stones, forming pools, riffles and narrow swift sections. This station was seined by Carl L. Hubbs and family, on June 26, 1938.

Station 5. Mouth of Tornillo Creek, tributary to Río Grande, where the elevation is 1,850 feet. Here another collection was made by Leo T. Murray and party of Baylor University Museum, on July 20, 1938. The specimens seem to represent a sample of the fauna of the Río Grande proper, as might be expected since the creek is mostly dry except after heavy rains.

Station 6. Terlingua Creek, 12 miles above its mouth (into Río Grande). The only collection from this creek was seined by Leo T. Murray and party of Baylor University Museum, on July 30, 1938.

For the opportunity of making this study I am very grateful to the collectors of the material, not only staff members of the University of Michigan Museum of Zoology, but also, and particularly, to Prof. Leo T. Murray of Baylor University Museum. Dr. Murray has also contributed a number of pertinent facts and suggestions.

Further exploration will no doubt materially increase the fish fauna of the Big Bend region, and add other springs and streams to the list of waters which harbor fish. Mr. H. B. Parks, of San Antonio, Texas, writes that he has seen fish in the apparently perpetual water hole at Cattail Falls, at the extreme southwest corner of Chisos Mountains, and suggests that there may be other permanent pools, with fish life, to the south and southwest of the Chisos.

CHARACIDAE

1. *Astyanax fasciatus mexicanus* (Filippi)

Station 4. Peña Colorada Creek (27, young to half-grown). Station 5, Tornillo Creek (2, half-grown to adult).

This is the only characin recorded from the United States, and would be expected to occur in the Big Bend region. Mr. Hunt, a college student at Marathon, informed me that the "silversides" occurred in Peña Colorada Creek before the introduction of fish into the region.

The status of the northern subspecies of *Astyanax fasciatus* is being treated by Hubbs and Gordon (MS.). The material at hand exhibits the low average number of anal rays characteristic of *A. f. mexicanus* (Table I).

TABLE I

Anal Ray Counts for *Astyanax fasciatus mexicanus* from Big Bend Region, Texas

	Anal rays			
	19	20	21	22
Pena Colorada Creek	3	10	11	1
Tornillo Creek	1	1	..	..

CATOSTOMIDAE

2. *Carpiodes carpio elongatus* Meek

Station 5, Tornillo Creek (104, young). Station 6, Terlingua Creek (7, young).

Hubbs and Gordon (MS.) are discussing this Mexican and Texan representative of *Carpiodes carpio*. The young taken in Tornillo Creek were probably the progeny of adults from the Río Grande.

CYPRINIDAE

3. *Extrarius aestivalis sterletus* (Cope)

Station 5, Tornillo Creek (1, young).

The single specimen from the Big Bend region has the small eye and prominent snout of this Río Grande form, the validity of which is being indicated by Hubbs and Gordon (MS.).

4. *Notropis jemezanus* (Cope)

Station 5, Tornillo Creek (2, young to half-grown).

Hubbs and Gordon (MS.) are also treating the status of this form, which is characteristic of the Río Grande and its tributaries in New Mexico, Texas, and northeastern Mexico. There are no published records for Texas, but the species also occurs in a collection at hand from the Río Grande at Laredo.

5. *Notropis lutrensis blairi*, new subspecies

Maravillas red shiner

Station 3, Garden Springs (16, half-grown to mature males and females). Station *3a*, Garden Springs (25, mature males and females). Station 4, Peña Colorada Creek (10, mature males and females).

These are the only known specimens of the subspecies, and all are designated as types. The holotype, a nuptial male 44 mm. in standard length, is from Station 3.

Diagnosis.—This new subspecies is similar to *Notropis lutrensis lutrensis*, but has a smaller dorsal fin, the origin of which is usually more posterior (Table II). The lateral line is complete, and the scales are not markedly reduced in size. The anal rays usually number 9 but often 8 (Table III). The relatively thick and slender adults (Table II) show little sexual dimorphism in form. Nuptial tubercles of relatively small size are scattered over the top of the head, but none are developed around the tip of the snout. These contact organs are comparatively weak on the body except in vicinity of anal base, where they form an almost solid shagreen. The mouth is rather strongly oblique, and the lower jaw, characteristically, is only slightly or not at all included. The snout is broadly rounded, in top and side views. The eye is small. The black mark between the mandibles is well developed, and extends to opposite the root of the mandibles. The shoulder bar is very prominent. The body is rather strongly cross-hatched, and the general color tone is dark.

Life Colors (described at Peña Colorada Creek on June 26, 1938).—Breeding males are predominantly olive-green, with bright gilt reflections. They are strongly spangled with blue on the anterior two-thirds of the body, and show considerable pinkish gold on the light part of the abdomen. The top of the head is dusky purplish, with iridescent green. The silvery opercles, with brassy and bluish reflections, and the bright blue cheeks, add to the attractiveness of this fish. The indigo and rose bars behind head are fairly conspicuous. The caudal and lower fins are bright orange-red with paler outer borders. The pectoral and anal are almost blood-red on the membranes. The dorsal fin is slaty. The general appearance is unlike that of typical *lutrensis*.

TABLE II

Comparison of two populations of *Notropis lutrensis* from the Big Bend Region

	Glenn Spring (*N. l. lutrensis*)	Pena Colorada Creek and Garden Springs (*N. l. blairi*)
Tubercles on top of head in breeding males	Large; in high males forming a projecting pad around tip of snout	Small; not developed around tip of snout
Muzzle in side view	Rather sharp	Broadly rounded
Lower jaw	Definitely included	Slightly or not included
Base of caudal to origin of dorsal when measured forward extending to any point	Between middle of eye and anterior fourth of snout; usually to anterior nostril	Between posterior rim of eye and posterior nostril; usually to front part of eye
Length of depressed dorsal in distance forward to occiput		
In breeding males..........	1.0 to 1.3	1.3 to 1.5
In adult females...........	1.2 to 1.6	1.4 to 1.7
Depth:		
In breeding males..........	2.7 to 3.3	3.4 to 3.8
In adult females...........	3.2 to 3.6	3.3 to 4.0
Body	Slab-sided	Thick
Sexual dimorphism	Strongly marked	Relatively slight

TABLE III

Anal Ray Counts for *Notropis lutrensis* in the Big Bend Region

	Anal rays		
	8	9	10
Notropis lutrensis blairi			
Garden Springs.................................	7	34	..
Pena Colorada Creek..........................	2	8	..
Notropis lutrensis lutrensis			
Glenn Spring....................................	7	56	2
Tornillo Creek..................................	1	1	..
Terlingua Creek................................	2	3	..

The specimens from Peña Colorada Creek near Marathon average slightly deeper than those from Garden Springs, but obviously represent the same form. This would surely be expected, since according to local testimony at Marathon the Peña Colorada flows after heavy rains past Garden Springs (after having flowed by other springs 2 miles less distant downstream), and thence into and down the usually dry Maravillas Creek bed. At such times the outflow from the springs no doubt often connects with Peña Colorada Creek, allowing the transfer of fish. A heavy rain had occurred immediately before our visit on June 26, 1938, as the first precipitation of consequence in 6 months, and the large flow in the creek was presumably sufficient to carry the stream the 8 miles to Garden Springs (if the intervening reservoir were full). As the Peña Colorada and the Maravillas subside, again according to local information, there are left stream-bed pools which in turn gradually dry up, making it easy to catch the game fish which have been washed down from the tanks and "lakes."

Although Maravillas Creek flows intermittently to the Río Grande, perhaps once or twice a year, no extensive transfer of fish would seem to take place. As Dr. Josselyn Van Tyne tells me from experience, the Maravillas when flowing is a raging torrent, which subsides too rapidly to allow fish to migrate any considerable distance up the usually dry stream bed. The fish population of the Peña Colorada (including Garden Springs) thus seems to be effectively isolated.

As very commonly throughout the arid West, such isolation is reflected in the differentiation of the fishes which inhabit the fragmented water systems. Were is not for the variability of *Notropis lutrensis*, the Peña Colorada form would appear to warrant full specific separation. It is obviously a distinct and presumably a very local form. It contrasts sharply (Table II) with the population of typical *Notropis lutrensis lutrensis* inhabiting Glenn Spring, which though not far distant in miles from the Peña Colorada has probably long been separated in terms of years.

It is not possible to say whether *Notropis lutrensis blairi* represents an offshoot from typical *lutrensis*, or whether it is a primitive remnant, preserved through isolation, of an original Río Grande form which has been overwhelmed in some parts of the system by an incursion of the more specialized *N. l. lutrensis*. The relatively generalized characters of *N. l. blairi* and its resemblance to isolated races occurring farther west provide evidence in favor of the view that it is a relict form.

This subspecies is named for W. Frank Blair, in recognition of his part in the collection of many fish specimens, including the first examples of *N. l. blairi.*

6. *Notropis lutrensis lutrensis* (Baird and Girard)

Station 1, Glenn Spring (1332, half-grown to mature males and females). Station 5, Tornillo Creek (2, half-grown). Station 6, Terlingua Creek (5, young to adult).

The status of this form has been discussed by Hubbs and Ortenburger (1929: 73-76) and will be treated further by Hubbs and Gordon (MS.).

The many specimens taken in Glenn Spring, contrasting with those from Garden Springs and Peña Colorada Creek, correspond very well with the ordinary *Notropis lutrensis lutrensis,* which ranges from northeastern Mexico to Illinois. The characters are given in Tables II and III.

Dr. Van Tyne tells me that Glenn Spring is a small piece of water thoroughly separated from the Río Grande (about 8 miles distant) by a steep wash which is almost always dry. It would seem to be quite as isolated as Peña Colorada Creek. But differentiation of isolated populations seems to follow no very definite pattern, in terms of either space or time.

The limited samples from Tornillo and Terlingua creeks, on either side of Glenn Spring, are inadequate to determine whether they represent races as typical of *N. l. lutrensis* as the one which abounds in Glenn Spring. The anal rays would seem to average fewer (Table III). The Tornillo and Terlingua specimens seem nearer to *lutrensis* than to *blairi*, as may be seen by comparing the following data with that given in Table II.

The 2 specimens from Tornillo Creek, 23 and 26 mm. in standard length, approach *blairi* in the form of the muzzle. The origin of the dorsal fin is midway between the base of the caudal and the posterior nostril or the front of the eye. The length of the depressed dorsal enters the distance forward to the occiput 1.25 times. The depth measures 3.5 or 3.6 times in the standard length (the young of *lutrensis* are much slenderer than the adults). The body is strongly compressed.

The 5 fish from Terlingua Creek, 16 to 33 mm. in standard length, are very much like those from Glenn Spring. Following are the critical determinations for one breeding male 29 mm., and, in parenthesis, for two females 33 mm. long: tubercles on top of head large; muzzle rather sharp and lower jaw definitely included (in both sexes); origin of dorsal midway between base of caudal and anterior nostril (front of eye or anterior nostril); length of depressed dorsal, 1.15 (1.4 or 1.5); depth, 3.3 (3.6) (the body rather slender, as usual in stunted adults); body slab-sided.

7. *Notropis braytoni* Jordan and Evermann

Station 5, Tornillo Creek (11, half-grown to adult, including dwarfed nuptial males).

This Mexican species, which is being redescribed by Hubbs and Gordon (MS.), has not been recorded in the United States. Other specimens, however, are at hand from the Río Grande at Laredo, Texas.

The Tornillo Creek specimens have a rather large head (3.3 to 3.6), but in this species the head becomes relatively much shorter in large fish. The eye measurement is 3.7 to 4.3.

8. *Notropis chihuahua* Woolman

Station 5, Tornillo Creek (2, half-grown). Station 6, Terlingua Creek (1 mature male 25 mm. long and 1 mature female 41 mm. long).

These are the first records for the United States of this Mexican species.

Diagnostic features of *N. chihuahua* derived from these specimens are as follows: teeth 4—4; anal rays 7 (1 specimen from Station 6) or 8 (all others); nuptial tubercles on the pectoral rays not in a band as in *N. deliciosus*, but in one row, forking once;

lateral line scales scarcely elevated anteriorly (unlike those of *N. volucellus)*; sides of body with irregularly scattered giant melanophores, which are not especially concentrated along the lateral lines; basal caudal spot small, black, well out on the rays; posterior part of dorsal base blackened.

9. *Dionda episcopa episcopa* Girard

Station 5, Tornillo Creek (1, half-grown).

On the basis of its 7 anal rays and its rather chubby body and rounded fins, the single specimen of *Dionda* from the Big Bend region seems referable to the typical subspecies, otherwise known from the Pecos River system of Texas and New Mexico. The subspecies of *Dionda episcopa* are being discussed by Hubbs and Gordon (MS.).

10. *Hybognathus placitus amarus* (Girard)

Station 5, Tornillo Creek (3, half-grown).

The status of the Río Grande and Red River form of *Hybognathus placitus* will be elucidated elsewhere.

11. *Pimephales promelas confertus* (Girard)

Station 5, Tornillo Creek (13, young to half-grown).

This species and the preceding were expected members of the Big Bend fish fauna.

12. *Campostoma ornatum* Girard

Station 6, Terlingua Creek (2, young and half-grown).

This Mexican species (see Meek, 1904: 41-42) has been recorded from the United States only from Rucker Canyon, Arizona (the type locality of the nominal species *campostoma pricei)*. Its distribution in Texas is probably very limited. The scales number more than 70 along the lateral line.

POECILIIDAE

13. *Gambusia gaigei* Hubbs

Station 2, spring at Boquillas (63, half-grown to mature males and females).

So far as yet known, *Gambusia gaigei* Hubbs (1929) is confined to "a marshy cattail slough fed by springs, located close to the Río Grande at Boquillas, Brewster County, Texas, opposite the Mexican village of the same name." Dr. Van Tyne tells me that this is the largest river-side spring in the Big Bend region, and one of the few permanent waters of the region. Prof. Leo T. Murray writes that "This cattail slough was being eroded rapidly by side cutting of the Río Grande in flood when I visited Boquillas in Aug., 1938. If the process went on long after I was there, this type locality is gone. The fish, however, will persist in the spring above the flood plain."

That some species of *Gambusia* occurs in Peña Colorada Creek was indicated by the testimony of Mr. Hunt of Marathon. He claimed that a transparent topminnow with "pot got" lived in this stream (where flowing permanently, 4 miles southwest of Marathon), along with "silversides" *(Astyanax),* before bass and "perch" *(Apomotis* presumably) were introduced. Some topminnows may be holding out in spring heads but our thorough search of the creek failed to disclose any. They may well have been consumed by the introduced centrarchids.

CENTRARCHIDAE

14. *Huro salmoides* (Lacépède)

Station 4, Peña Colorada Creek (2, yearlings).

15. *Lepomis cyanellus* Rafinesque

Station 3*a*, Garden Springs (2, half-grown). Station 4, Peña Colorada Creek (4, yearling to adult).

Mr. Hunt, a college student interviewed at Marathon, claims that the bass and "perch" were introduced into the tanks and lakes of the region, from which they are carried downstream in floods. As the stream-bed pools dry up again, these fish are very easily caught. This information as to the introduction of *Huro salmoides* and *Lepomis cyanellus* into the Peña Colorada is probably correct, though it is conceivable that both are native in the region.

It is possible that *Lepomis cyanellus* is now spreading its range in the region. W. Frank Blair indicated that *Notropis lutrensis blairi* was the only fish in Garden Springs when he collected there April 16, 1937. Two of the sunfish, however, were caught there by the Baylor University party on July 19, 1938 (after high water in June).

The adult sunfish caught on June 26 was very bright. Its body was densely spangled with blue and the caudal and lower fins were deep orange inside blue-white borders.

As indicated above, the introduced bass and sunfish may decimate or even annihilate the small, native fishes of the Big Bend region. The capacity of introduced large-mouthed bass *(Huro salmoides)* to destroy small, native fishes is indicated by the remarks of Harrison (1934: 7, 29-30, 86) and Howell Rivero (1937). It is to be hoped that further introductions will not be attempted.

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CAN THE SOCIAL SCIENCES OVERTAKE THE NATURAL SCIENCES?*

By Oscar A. Ullrich
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Over twenty-five hundred years ago, the intellect of man discovered precise methods of thinking and invented adequate symbols for expressing exact thoughts. These methods together with the language devised are commonly referred to as logic and mathematics. With the use of these mental tools, the intellect has been able to reveal many of the secrets of nature, has been successful in releasing the power imprisoned in such resources as coal, oil, iron and water, and has learned to harness with bands of steel the forces released. So marvelous has been this development that according to economists a home-maker in a well-equipped household has the power of fifteen horses at her command, and that any motorist speeding along the highway may direct the power of ninety or more horses with a turn of the hand. These illustrations may be multiplied a thousand times from the sciences of chemistry, physics, biology, geology, and the rest of the natural sciences.

But the intellect of man has failed to develop sufficiently well in his fellows the ability to handle or to ride these horses with safety. The problem of controlling these forces and using them in the interest of human betterment is, of course, not new. Even Socrates in his day applied his intellect to the task of searching for the mathematics of social behavior. While his contemporaries were discovering and formulating the laws governing the behavior of matter and of animal and plant life, he and his colleagues looked for comparable laws which were thought to underlie the behavior of humans in relation one to another. Unfortunately, many successors of that immortal trio, Socrates, Plato and Aristotle, have directed their attention to and spent their energies in meditating almost solely on metaphysical and theological problems. The interest in the other world may have served a useful purpose at the time, but it deflected too much the attention from the needs of this world, the need for more of Heaven on earth. In any event the race between the natural scientists and the social scientists has been an unequal one. The former group has taken such tremendous strides that the latter is hardly in hailing distance. The confusion in social science is so confounded that one may even question the right of the latter group to the use of the term science. In matters of social behavior, humans find themselves in the predicament of the blind leading the blind. Even our Chief Executive confesses to be experimenting with many problems which should have long since been solved by experience.

* Read before the Social Science Section of the Texas Academy of Science at its annual meeting November 10, 1939, Austin, Texas.

Little wonder that sober minded men here and there are sounding the alarm that Frankenstein monsters, not Martians from another world, are upon us threatening our destruction. To justify their alarm, they need to point only to the cost of the World War in terms of precious human stock, to say nothing of what the present war in Europe portends. The blessings which would accrue to the human race if the ingenuity, the skill, the energy, and the accumulated wealth now spent on wars and preparation for wars were turned into productive channels or used for programs of social betterment is beyond calculation. No one is able to make sense out of the periodic slaughtering of masses of our youth, and yet no one seems able to do anything about it. One would suppose that Europe after three centuries of public education would have enough men dominated by intelligence to prevent the mass destruction of its best human stock.

It seems to be an irony of fate that nations with educational systems adjudged best to find themselves in the worst possible predicaments. Leaders in education all along have cherished high hopes for their people through programs of education. Martin Luther in the sixteenth century proclaimed that the education of the masses is necessary for the "sake of affairs here below." Comenius, Pestalozzi, Herbart, Froebel, and all the others believed firmly in the proposition that general education would uplift mankind. The founders of our Republic and many of the signers of our national constitution subscribed to the view that the education of the masses is a necessity for a democracy.

Yet the confusion among and the frustrations of the peoples of all so-called Christian nations gives clear evidence that educational systems, no matter how perfect the technique, have failed alarmingly. The unsolved question was and still is, education for what? The proposition that education is a necessity for a democracy rests on three assumptions: (1) that the intellect dominates the emotions and functions as the guide for and the dictator of man's behavior, (2) that man acts in accordance with the best knowledge or information at his disposal, and (3) that education given in sufficient amounts increases intellectual capacity. Today, the psychologist questions all three of these assumptions. Studies in social psychology reveal that in three out of four cases men vote their feelings on political questions rather than their convictions. Additional evidence in support of this point is furnished by some of the types of individuals who succeed in winning elections to political office. Ample evidence in refutation of the second assumption is supplied by the European scene. Simple calculations and a knowledge of the cost of the first World War give proof that neither side can profit by a modern World War. But one need not look to Europe for examples. The ingenuity we show in placing obstacles in the way of conserving natural resources and of improving the living conditions of the submerged third of our population borders on the phenomenal. Our greed so blinds us that we prefer to bankrupt our business rather than distribute the profits so that all may enjoy richer lives. Finally, every educator can testify to the fact that some minds simply can not be made to sparkle if in them the biological elements are not properly mixed, no matter how long the individual remains in school. If more education could make for more brain quality, the millionaires could have the braniest progeny.

In view of the evidence cited, the conclusion seems warranted that education as now practiced will not solve our problems or save our civilization. Some other program must be found, which will, if not replace, at least supplement education. Such a program has been advocated by biologists and anthropologists. These gentlemen insist that the solution of many of our difficulties must await a thoroughgoing program of racial betterment, an improvement of our human stock. Unless this is done, they contend, we may entertain little hope for the future. To the intellectual minority, they claim, all human progress is attributable, and if this minority is allowed to become extinct because of wars, birth control, or starvation, and if the socially unfit are permitted to procreate their kind, our culture will disappear. Professor Hooton of Harvard fears that we may be too late already. In his two volumes, "Apes, Men and Morons" and "The Twilight of Man," he suggests a program of selective mating among the best, and the restriction, even elimination, of the unfit in a humane but effective manner. Instead of plunging into a stream to save a man trying to commit suicide, he advises us to stay on dry land and to watch the bubbles. He continues to argue that if the unqualified are allowed to take charge of our governments and industrial systems, the human species will be driven headlong toward destruction.

Whether or not an effective program of race betterment can be carried through, and whether such a program would make for social betterment, no one can at present say with any degree of finality. However, one may reasonably suppose, that by a program of selective mating the socially desirable traits can be preserved and possibly better ones created, whereas the undesirable individuals could be eliminated gradually by restrictive measures. That the results of such a program would be desirable need not be argued. The difficulties in the way, however, are formidable. Who is to formulate such a program? And who is to be entrusted with its execution? While man may be willing to apply the laws of heredity to plants, animals, and perhaps even to his neighbors, he will hesitate to apply them to himself. The ineffectiveness of the restrictive laws on the statute books of some thirty states gives proof of man's reluctance to apply a sterilization program to society. Thus far, practically nothing is being done on the positive side to encourage the fit to seek their kind for the preservation of the good stock. Hence, those who are waiting on race betterment before expecting social betterment, may have to wait a long time, perhaps until blind forces outside of human control purge the race by the process of the survival of the fittest. If eventually the earth should become overstocked with humans, one might suppose that those with the smallest stomachs and at the same time in possession of the keenest intellects and hardiest bodies would win in a competitive struggle for existence, assuming of course that religious considerations are negated.

Since the social scientist can not in the immediate future expect a remedy from the eugenist, he must return to education for his method. The responsibility of pointing the way, at least of attempting a solution, is clearly his. He must accept the challenge and take the risks of all reformers. In the spirit of humility, the author suggests that the social scientists formulate their mathematics of social control, and submit their formulae to the educators as well as to the statesmen for application in the educational system. The author further ventures to suggest in outline form the "mathematics" governing human conduct. If the axioms and propositions are correctly postulated, the theorems and their corollaries should enable us to construct formulae for safe human guidance.

From the social viewpoint, the all-inclusive law might read as follows: The good of society coincides with the good of the individuals. The terms "good" and "society" are here used in their broadest sense. Obviously, when the desire of an individual conflicts with the good of society, the individual must yield; and when the best interests of the individuals are blocked, the social form must be changed. This principle was recognized by the founders of our Federal Government as shown by the inclusion, in the national Constitution, of the "general welfare" Clause and in the provision for amending the Constitution. Only on this assumption is a general conscription law and an "M Day" justifiable. Moreover, this principle has received the approval of our people in many other directions even for peace-time conduct. The right of eminent domain, the nationalization of the postal system, the coinage of money, the pure food and narcotic laws, all testify to the acceptance of this principle.

This primary law of the good of society may be used conveniently as a test for proposed legislative measures as well as for existing social practices. The most exacting practical question is, how does one know which specific practice is good for the the whole? or which measure is in conflict with the good of society? The answer for a given measure at a given time must be sought pragmatically, rationally, or by the experience of the race as revealed by history, or by all three methods combined. For example, if it could be shown that the consumption of alcoholic beverages makes for safer driving, then all drivers should be required to take a drink before taking the wheel. If gambling should prove beneficial to society, all children should be taught to gamble. If society is best served by a system of production for profit rather than by a system of production for use, all good democrats should vote for the former. If more individuals are happy when two hundred families own and control eighty percent of the wealth, than the other way around, laws to preserve this system should be enacted. If the wholesale destruction of our forests is good for society, we should promptly cut them down. If the destruction of one-third of our crops in one part of the country while people in another section are starving is beneficial all the way around, the better part of wisdom is to destroy the crops. The experiment in communism need hardly be repeated in America after the experience of Captain John Smith in Virginia during the early colonial days. History may also teach us a few lessons with regard to the "dole" and the "ham and egg" experiments.

If the thesis that the good of society coincides with the good of the individuals be accepted, it follows that society has the inalienable right to maintain and perpetuate its existence. To this end society is justified in repelling invasions from without and supressing and purging itself of conspiracies from within. Moreover, it is justified in resorting to any expediency necessary in preserving its wholeness. When a society is fighting for its existence, all attempts to prescribe rules of warfare are likely to be futile. Once the decision to destroy one's enemies is reached, it matters little how one goes about it, whether with bullets, gas, or starvation. The victims will be as dead one way as another. To legalize a given method of destruction beforehand may serve a useful purpose if by so doing one can drug the conscience of certain conscientious objectors or win the support of allies. The record of human conflicts from the earliest times to the present substantiates this point. The right to maintain itself also involves the right to secure food and other necessities. A starving people will seek and if necessary fight for, sources of food supplies. Perhaps, it is around this economic question that all large scale modern wars gravitate as the chief cause, as Burns has ably demonstrated in his treatise entitled "Population Pressure."

If the right to existence be conceded to a given society, one must perforce also grant it the right to replace itself. Obviously, then, society has the right to prescribe the conditions under which it reproduces itself. Since the process of replacement goes on gradually and continuously, this right is concerned with such problems as marriage and divorce, the care and education of children, child labor regulations, public health and the like. It seems clear that if the best results for the nation are to be secured, the laws governing marriage and divorce as well as the general aspects of child welfare should be national in scope. Laxity on the part of certain states in this matter tends to nullify the beneficial requirements in other states. In this matter society might also exercise the right to determine whether or not certain types of the socially unfit and congenitally diseased should be allowed to reproduce their kind and thereby to weigh down the socially capable.

If now we reverse the position and view the picture from the standpoint of the individual, it seems clear that any discussion of the good of society involves a consideration of the good of the individual and his relation to society. Contrary to the extreme view of some that the State is all important, and contrary to the view of others that the individual is all important, the view is here taken that neither of these extreme views is correct and that the best interests of the State can prevail only when the best interests of the individual are served; and that the best interests of the individual can in the long run obtain only when the best interests of all are secured. In the words of Kipling and in a limited sense, "the strength of the wolf is the pack, and the strength of the pack is the wolf." Time and circumstances do not permit of an elaboration of this view. Suffice it to say that a society without individuals is unthinkable, and an individual without social connections, a mate and children, would soon become extinct. Hence, the best interests of the State and the best interests of the individual are in the long run identical.

In its task of guiding and controlling human conduct, the race has proposed and experimented with several formulae. Plato proposed Philosopher Kings, who would rule by the irresistible force of reason. The practical difficulty is that every ruler or would-be ruler regards himself as wise and just when as a matter of fact he is frequently dominated by emotions, chiefly vanity. The soldier-king idea has been tried repeatedly, and is now in vogue in the so-called totalitarian states of Germany, Italy, Japan and Russia. The underlying notion seems to be that the leaders are appointed by Divine Providence, or else rule by the Grace of Nature. In the eighteenth century a group called physiocrats held that natural laws comparable to physical and biological laws in the long run determine human conduct. This idea was applied especially to economics. Perhaps inspired by this view, if not as an outgrowth of this idea, the founders of the government of the United States decided that each individual had certain inalienable rights, and that these rights could never be taken from him by any power on earth. The rights summarized were "the right to life, liberty, and the pursuit of happiness." These rights were further elaborated and specified in the Constitution as "the Bill of Rights." However, this Bill of Rights is limited by and set into the frame-work of the "general welfare" clause of the same Constitution. It was assumed apparently that no serious conflict between the individual and the state could arise as long as all individuals sought the general welfare. Since one human is by nature like every other human with a heart and a head, it was assumed that basically he had identical needs and of course identical rights. Note the statement "that all men are created equal." If it be conceded that men should have equal rights, it follows that all must submit gracefully and willingly to the will of the majority. Only when this principle is agreed to and acted upon can democracy survive. The attitude in line with this principle must be fixed in all and geared to the patterns of social conduct. Accepting the view that all men have equal rights, and that all have identical basic needs, it follows that each individual has the following inalienable rights; first, equal opportunity to work and procure food, clothing, and shelter; second, the right to marry and rear a family; third, the right to own property; fourth, the right to security of person and property; fifth, the right of freedom of speech and of the press; sixth, the right to enjoyment of life; and seventh, the right to worship God according to the dictates of his own conscience.

The need for food is second only to the need for air and water. Since air and water are plentiful, no problem except in isolated cases arises in the satisfaction of these needs. Not so with food. To acquire this commodity, some men must apply their skills and energies to natural resources. To do this they must have access to the natural resources, and every man must or should do his share of productive work, either by working natural resources or by rendering useful service for those who do. Those who for some reason render no service or do no creative work live at the expense of those who do. The number of eleemosynary institutions, therefore, is a measure of the weakness of a society. The larger the number that for some reason does no work, the heavier the weight of dependents and the less the workers can enjoy of the fruits of their labors. To the load of unfortunates must be added, the criminals, the gamblers,* the beggars, and the rest of that type.

The second inalienable right of an individual is that of selecting a mate. In the contractual relation of marriage, however, neither mate may presume to enjoy a liberty greater than that of the other. The more rights granted to the one, the less is left for the other. In any case, the society has an interest in the solidity and wholesomeness of a family unit. As already indicated elsewhere, the regulations for marriage and divorce should be uniform for the entire nation. Moreover, while an individual may claim a right to marry, society may withhold the right of feebleminded and other socially unfit to procreate their kind. The extent to which society may be expected to feed, clothe, provide shelter, and amusement for those who cannot or will not engage in productive work has not been determined. The requirement of good health, freedom from social diseases, and hereditary weaknesses does not seem to be unreasonable.

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* According to Ripley in a radio broadcast, November 15, 1939, the daily gambling bill of America is $12,000,000.

The right to earn and own property and enjoy the free use thereof seems necessary for the safety and security of any state. Adequate laws designed to protect an individual in the possession of his property seem necessary.

The right to security of person and family from unlawful arrest or molestation is so well recognized that it need hardly be elaborated upon here. Every person must have equal rights in the eyes of the law. To grant one individual more power or consideration than another means inequalities. The more power one person has, the less there is for all the rest. In its extreme form this leads to a dictatorship commanding a horde of slaves.

The right of freedom of speech, freedom of the press, and freedom of public assembly must be guaranteed. This freedom must not be construed to mean freedom to commit acts of violence. Acts of violence always end in the denial of freedom to others. Changes in governmental measures should be made in a peaceful and orderly fashion after the majority is convinced that such changes are for the best interests of all, and after the majority has expressed its desire to make such changes. The freedom of speech, of the press, and of assembly, therefore, should include the freedom to reason with and to convince others to the end that changes for the better may be made.

The right to enjoy life and to pursue happiness within the limits of social welfare must be guaranteed to everyone. Obviously, no one may reasonably claim the privilege of motoring, of speaking, of acting in a manner harmful to others. A city dweller, for instance, may not disturb the quiet of a neighborhood all night by exploding fire crackers, no matter how much enjoyment he may derive from such sport. However, all words or acts of a non-social nature should be left entirely to the discretion of the individual. Interference in matters strictly personal is just as reprehensible as placing obstructions in matters of a social nature.

Finally, every one should be allowed to worship God according to the dictates of his own conscience, provided the religious practices do not conflict with the best interests of society. A good God certainly favors the greatest good for all. Conceivably a small group may chance to adopt practices under the name of religion which militate against the best interests of society. In such cases, society has the right to suppress the practices. Polygamy and nudism may serve as examples.

By way of summary, then, we may contend that the basic law is as follows: "The best interests of the whole are identical in the long run with the best interests of the individual. The test of a good measure then, is to determine whether or not it is for the good of the whole. The rights of the individuals are inalienable only within the framework of this law, and may be regarded as corollaries thereof."

As indicated previously in the discussion, the principles presented may be inadequate. They may even be regarded as trite. None-the-less, it would seem worthwhile for qualified political scientists, economists, sociologists, psychologists, and educators to assemble in a national convention for the purpose of formulating a rational social code adequate for our time, perhaps for all time. The terms "rational" and "for all time" are used purposely. "Rational," because there may be universal truths in the social realm comparable to those discovered in mathematics; and "for all time," because such truths as may exist would have validity as long as mathematics has validity. If such laws exist, a social science may be established, if not, social conduct will always remain particularized in the realm of expediency.

At present the chief task seems to be that of gearing the emotions to the intellect, that of so training the youth that it will make a virtue of acting intelligently. In this undertaking, educators might very well take the lead, although the efforts of parents in this direction would seem to promise the best results.

Can social science overtake the natural science? Recognizing the complexity of social problems, and the fact that social scientists must deal with multiple-factors, the author believes that it is possible for the social scientists to reorganize their field of work and to utilize the discoveries and inventions of the sciences for human betterment.

RESEARCH RESULTS OF SOIL AND WATER CONSERVATION IN TEXAS

By R. E. Dickson
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Some of our greatest agricultural developments, and ones that have added immeasurably to our agricultural wealth, have been through the converting of waste products into useful channels. Two outstanding examples of these developments which are familiar to most everyone are the extensive uses that are now being made of the products of the cotton seed and the thousands of excellent by-products of the packing house. Much new wealth has been created, a considerable portion of which has found its way back to the producer.

In the past few years many new uses have been found for raindrops which, when allowed to flow uncontrolled over the farms and ranches, have taken a heavy toll of soil and soil fertility through erosion, and when joined by other multiplied millions of raindrops have have formed vagabond streams leading to the sea, causing floods over wide areas with great destruction of property. Only a few years back cotton seed and much of the livestock carcass were also liabilities.

Is it not reasonable and plausible to assume, in a region where all plant life suffers at some time during the year for lack of moisture, that something practical can be done in the saving of water when it is abundant and free for use by plants when it is most needed? The impounding of flood waters in reservoirs and pumping from subterranean streams and lakes for irrigation has been highly developed in many areas, but the soil itself has not yet been adequately studied and developed as a storage place for water. It is to this thought that I will address my remarks.

Shortage of soil moisture at critical periods in plant life is not confined to any particular rainfall belt, but most always occurs at some time during the year where the annual rainfall is 20 to 30 inches. Frequently it occurs where the rainfall is from 40 to 50 inches a year. A study of the soil as a storage place for water may well be undertaken in all regions where the cotton plant sheds its fruit and where feed crops burn as a result of a shortage of moisture in the soil. There are many factors that contribute to cotton yields, but possibly the most important is the abundance or shortage of soil moisture. The jump from a 2,401,000-bale Texas cotton crop in 1934 to a 5,154,000-bale crop in 1937 was due, for the most part, to differences in soil moisture.

Much emphasis heretofore has been placed on seasonal distribution of rainfall. It is now known, and is rapidly becoming generally known, that water may be stored in the soil for many months prior to the time it is to be used by plants. Specific examples of this fact observed by many were the green spots in the dry year of 1934 that occurred on areas where the plow-up of cotton took place in 1933. A check on soil moisture through these years revealed that there was an appreciable carry-over of moisture from the heavy rainfall of 1932 into the dry crop year of 1934.

When the Spur Station announced in 1926 that a field area would be treated with closed level terraces to prevent runoff, the experimental undertaking received considerable good-natured ridicule. Much to the surprise of all, including those who were directing the experiment, the closed level terraces worked and have continued to work for 12 years. There has been no runoff; no erosion; no crops damaged by excess water; crop yields increased 62 per cent, and the gross increased acre value of the cotton crop for the 12-year period has been $91.23 or an average of $7.60 per acre per year. There are now thousands of closed-end, level terraces in Texas.

A study of the soil moisture and plant relationship through checking on the water holding capacity of the soil, the available water in the soil and the water requirement of the cotton plant, revealed that the full capacity of the soil as a storage place for water was not being used. There still remained much space for water in the zone occupied by roots of the cotton plant. Water was brought in from a nearby highway, and the amount of water supplied by the normal rainfall was increased by 19.5 per cent.

Other experiments conducted with the sorghums, alfalfa and native grasses show they possess the ability to use much larger quantities of water than cotton, which leads to the thought that in cases where large amounts of water are available that plants capable of utilizing large amounts of water should be used. To illustrate, possibly the greatest mistake one could make would be to uproot a pine tree and plant a peanut in its place. Peanuts cannot possibly use as much water as pine trees. Neither can they use water for the long period required by the trees. The result is accelerated runoff and erosion. Neither by any hook or crook can the cotton plant be expected to use as much water as a good crop of grass or the soybean as much as clover. In an intelligent schedule for utilization of water much can be accomplished when the type of plant is matched with the water that is available.

We cannot pay too high a tribute to the intrepid explorers who have searched the earth for new plants that would add to our agricultural wealth. These men have contributed immeasurably to the fruits of harvest and merit the praise of all who are interested in agricultural development. On the other hand, it is possible that in our zeal to obtain new plants we have in many cases overlooked the potentialities of our native plants. This is true of our pasture plants, and the neglect of native buffalo grass is a specific instance. It is definitely known that with only a minimum of care buffalo grass will give a response that amply repays efforts expended in its behalf. Certainly where a plant of this kind responds readily to kind treatment it is worth while to determine what conditions are necessary to bring it into maximum production.

In my 30 years with plants I have never found any of the introduced plants that respond so quickly and so generously to a little kind treatment as the native prairie grasses. Grass yields have been tripled by inexpensive contour furrowing. The carrying capacity has been increased from an animal unit to 18 acres to an animal unit to 5 acres. Grass prevents raindrops from churning the soil surface into a muddy suspension and allows for quick and deep penetration of water. There is as much difference in getting water to enter a well-sodded grassland and fallowed land as there is in pouring water into a wide-mouth fruit jar and a small-neck bottle.

I am convinced there is a practical use for every drop of water that falls in most of Texas. When we have put forth the same effort to develop these uses that the packers have to find new uses for the by-products of the packing house or the cottonseed crushers have for new uses of the products of the cotton seed, we will have little runoff and erosion in Texas, and the risk element in farming and ranching will be reduced to the minimum.

THE CHROMOSOME COUNT IN THE ROOT TIPS OF A SPECIES OF POGONIRIS*

By Clare Whelan
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This paper includes notes on a species of Iridiaceae of the subgenus, Pogoniris. Plants studied were grown by Mr. George Allen of San Antonio, Texas.[1] The flowers[2] are of a uniform purplish-black color without veins, with a yellow patch on the throat and a beard of yellow, black-tipped hairs, all of which merit for this species its popular name, "Purple King." The relatively large size of the flowers would indicate a large chromosome count, since the size of the flower and the number of chromosomes seem to have a direct relationship. These plants breed true and were originally collected by Wallich, a Hollander, in Katmandu, in 1830.[3] It is one of the several Irises which requires a relatively dry habitat.

The first chromosome count made on Iris in America was made by Longly in 1928.[4] Since then the count has been made on many species. Chromosome counts are useful in determining strains from which a plant has come, in predicting possible results, in crossing two species, and in aiding taxonomists in identifying species. Practical breeders seem to feel that making a chromosome count is a waste of time because knowledge of the chromosome number is no aid in predicting mutations for which growers are constantly searching. They hold that a good hybrid is independent of the number of chromosomes, but is based upon whether the genes of the two species complement each other on combination.[5]

Chromosomes have been discussed at length. Perhaps it would be well to pause a moment and briefly review the nature of chromosomes. When a cell divides, it may divide by simple binary fission, which is amitotic division; or there may be a rearrangement of the nuclear material through a series of steps. These steps or stages are the prophase, metaphase, anaphase, and telophase stages. This type of division is called mitotic division. Chromosomes are formed in the prophase, i.e., the first stage. The linin network of the nucleus breaks up so that the chromosome granules rearrange in threads. Certain parts of the thread have heavier masses of chromatin material, making the thread appear beaded. These so-called beads divide lengthwise, causing the thread to appear double. Soon certain parts of the heavier masses fuse and the chromosomes are thus formed. In the second or metaphase stage these chromosomes arrange themselves in an imaginary plane through the center of the cell. Each of the chromosomes seems to be connected by minute fibers to the opposite poles of the cell. In making the count a polar view of this metaphase stage was used.

* Presented before the Collegiate Division of the Texas Academy of Science at the annual meeting, November 10, 1939, Austin, Texas.

In order to make the chromosome count, stained slides had to be prepared. In this technique, the method employed at the University of California, by E. B. Babcock, G. L. Stebbins, and J. A. Jenkins in their chromosome counts of a number of species of composite plants[6] was followed. The root tips were cut about 11 P.M. and fixed in "Craf" fixing fluid for a period of not more than 12 hours. This fixative contains formalin, acetic acid and chromic anhydride.[7] Using this solution eliminated the process of washing. This fixative was followed immediately by the ethyl-butyl alcohol schedule for clearing and hardening.[8] Because the process of washing with water had been eliminated, dehydration in the lower alcohols was unnecessary. The material was imbedded in paraffin and sectioned to ten microns. Advantages of using the above method are two-fold: the chromosomes are well preserved, and the time is shortened from the usual nine days to two days.

To stain the chromosomes, the modified Flemming's stain as described by Stockwell[9] was used. The stain has three dyes—gentian violet, which stains the chromosomes deep purple, safranin, which stains the nucleoli red, and orange G, which stains the cytoplasm orange yellow.

The actual count was made using an oil of immersion objective and a 10x ocular.[10] The magnification used was not sufficiently great to reveal the characteristics of the individual chromosomes. Our count indicated the presence of forty-four chromosomes. This count for the Pogoniris, Purple King, verifies the published account of this number in the Check List of Irises for 1930.[11]

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[1] Photograph taken of a plant one year old in Mr. Allen's garden on November 7, 1939.
[2] Plant flowers in March. Painted illustration made by Mr. Allen during flowering season.
[3] *Amer. Iris Soc. Alphabetical Iris Check List,* 1929, p. 220.
[4] *Amer. Iris Soc. Bull.* (1929) No. 52.
[5] Mr. George Allen, Iris breeder.
[6] "Chromosomes and Phylogeny in Some Genera of the Crepidinae," CYTOOLGIA, Jubilee Volume (1937), p. 188.
[7] Randolph, L. F., "New Fixing Fluid and a Revised Schedule for the Paraffin Method in Plant Cytology," STAIN TECHNOLOGY, Vol. 10, (1935), pp. 95-96.
[8] *IBID.*
[9] Stockwell, P., "A Stain for Difficult Plant Material," *Science,* N.S. Vol. 80, pp. 121-122.
[10] Chromosomes illustrated by a camera lucida drawing and subsequently enlarged twice.
[11] *Op. cit.* 1930.

BACTERIAL ANALYSIS OF DRINKING WATER IN A RURAL COMMUNITY NEAR AUSTIN*

By Carol McElroy
Austin High School, Austin

There are three main diseases carried through water—typhoid, cholera, and dysentery. Since I live in a rural community and drink well water, I wondered if the water were good and how to determine whether or not it was safe. I thought perhaps my neighbors would like their water tested; therefore, my project is the bacterial analysis of well water in my community. For my reference books I used *Standard Methods of Water Analysis*, sixth edition, published by the American Public Health Association. This book was loaned to me by Miss Ernestine M. J. Long, director of the St. Louis Junior Academy of Science. I also used *A Laboratory Manual of General Bacteriology* by Dr. Lewis, professor of bacteriology at the University of Texas. I received a great deal of help from Mr. Hahn, water analyst of the State Health Department Laboratories in Austin.

I tested fourteen wells in this community. These wells supplied eighteen families. I counted around 173 people that use these drinking water sources. There were only three wells dug by hand. All the rest were drilled and had pumps except three which were bored but had no pumps. The depths varied from twenty to a hundred feet. Almost all of the places had clean surroundings with the exception of two things; one place had a pig pen not over ten feet from a dug well, and a good many others let their cows graze around the wells. These physical conditions will later be correlated with the results obtained, both good and bad. The people were very willing to have their water tested, and some were very interested in the results that I obtained.

It is impractical to test for the disease organisms, since one organism in a liter is a heavy contamination and there would be a small chance to find it; therefore, an indicator group is used. An indicator group must be similar in all respects to the disease organisms; must be easy to find; must live and be constant in polluted water; and must be absent in good water. The coliform group is best. They are small, gram negative rods fermenting lactose, giving off acid and gas. No other organisms except one or two will ferment lactose and give off acid and gas.

In my problem I found that preparation was more than half the battle. There are so many ways that cultures and equipment can become contaminated. In fact, I spent over three fourths of my time washing and sterilizing glassware and making new culture media. For these reasons, I planted controls with all my runs to check on contamination.

After the collection bottles were washed and sterilized at

* Presented before the Junior Division of the Texas Academy of Science at the Regional meeting May 4, 1940, at Nacogdoches, receiving the Chicago Apparatus Award.

fifteen pounds for thirty minutes in the steam autoclave, I took them home and collected my samples in the afternoon, as I could not begin my analysis until the next afternoon; therefore, nearly twenty-four hours elapsed between collection and tests, which although not the best technique, is permissible if a negative test is expected. I did not sterilize my points of collection, but collected a bottle of water as the people drank it. In collecting, I was careful to take the lid off, fill the bottle, and put the lid back on in the shortest possible time so that any contamination would be from the water.

I usually began my analysis after school. The doors and windows were closed when I was working and the table was sterilized with 2% lysol. My water blanks consisted of sterile cotton-stoppered test tubes containing 90 cc. of sterile water. Most of my pipettes were home made. For the total plate count I used sterile nutrient agar. After shaking the sample vigorously, I transferred 1 cc. into the water blank. I shook the water blank and placed 1 cc. in each of two petri dishes. I poured in the agar, the temperature of which I had tested by holding it against my cheek; and mixed the water and agar with a rotary motion of the dish. After the agar solidified, I inverted the plates and placed them in the incubator at 37½° C. In practice, this temperature varied a little, but I tried to keep it as near as possible at the correct temperature. Since some of my authorities said to leave the plates in the incubator for 24 hours, and others said 48, I took counts at both 24 and 48 hours.

The presumptive test is the beginning of the test for the coliform group. I used sterile Durham fermentation tubes and lactose peptone bile media, Difco brand. I did not inoculate tubes with dilutions, but used the sample straight. Dr. Lewis' manual said to use 10 cc. of sample in 30 cc. of media. Since my tubes would not hold 40 cc., I took a 1:3 ratio of sample and media. I transferred by sterile pipettes 3 cc. of sample to the tubes and poured in 9 cc. of sterile broth previously measured. I placed the tubes in the incubator at 37½° C. for 24 and 48 hours at which times I noted the amount of gas formation, if any. A positive test consists of 10% gas formation in 24 hours; a doubtful test consists of no gas formation in 48 hours. All doubtful and positive tests have to be confirmed.

The partially confirmed test consists of streaking eosin methylene blue agar plates from tubes showing gas formation. I poured the agar in the plates and let it harden. I heated the platinum wire red hot, flamed the mouth of the fermentation tube, got a needle full of material, lifted my plate sideways in the air, and barely let the needle touch it with a swinging motion. My first trials showed the bad technique of cutting the agar with the needle. I inverted the plates and incubated them for 24 hours. Typical colonies, Escherichia coli, which are flat with a metallic sheen is a positive test.

The completed test has two steps: the inoculation of lactose broth with typical colonies, and the transfer of typical colonies to an agar slant. With a loop needle I scooped up several typical colonies and put them in a sterile fermentation tube of broth. I incubated them until gas was formed unless it took over 48 hours. If gas is formed, the test is positive. The agar slants are made by pouring about an inch of nutrient agar in a sterile test tube which is placed in a slanting position until the agar has solidified. Then I flamed the mouth of the test tube, loop needle, and cotton stopper and very lightly ran the needle contaminated with typical colony down the middle of the slant and incubated it for 24 hours at 37° C. Gram stains were made from the agar slant with four different solutions. Gram negative non-spore forming rods is a positive test.

The total plate count does not differentiate organisms; it merely shows the number of kinds of bacteria per cc. There may be hundreds of a perfectly harmless type. In doing different tests of the same well, I found that although the colony formations were nearly all the same, that the number varied greatly from time to time. From different wells, the numbers varied from eight to several hundred colonies per cc. Nor were the plates with the most colonies always the ones with E. coli. The places where the sample was drawn up in a bucket always had more colonies than the ones that were pumped or piped.

You can see on the chart I have made that several wells had positive tests one time; then a few weeks later had negative ones. This shows that the nature of the water changes from time to time and should be checked at regular intervals.

When I plated the E. M. B. from positive tests, four of them came out negative and five were positive. However, the only wells that were positive in both tests were No. 4, a hand dug well about 25 feet deep, and No. 5. The wells that in any test were positive are 1, 2, 3, 9, 10, and 13. All the dug wells had positive tests and most of the wells that were drilled but had no pumps. I think I know why all these wells have positive tests. At all of the places where I got positive tests, the cows either are brought up to the pump for their water or are allowed to graze around the pump.

Mr. Hahn of the State Health Department kindly offered to check my analysis for me. I was very glad because I didn't want the people to stop using their water unless it was really bad. (State Health Department results were the same as those obtained by the student.)

I reported the results to the people and suggested that they clean up the area surrounding the pump. A few days later when I collected some more samples, I found that No. 13 had removed their pig and were getting ready to tear down the pen. As soon as each well is cleaned around, I intend to recheck to see if it was the surroundings that made the water bad.

BACTERIAL ANALYSIS OF DRINKING WATER

Jollyville Community, near Austin, Texas

WELLS	Date of Collection	Presumptive Tests		E.M.B. Tests	Completed Tests		Date of Collection	Presumptive Tests		E.M.B. Tests	Completed Tests	
		24 Hrs.	48 Hrs.		Broth	Slide		24 Hrs.	48 Hrs.		Broth	Slide
1....................	3/ 6/40	—	+	+	—		3/17/40	—	—			
2....................	3/24/40	—	—				4/15/40	—	+			
3....................	3/ 6/40	—	—				4/21/40	+	+	+	+	+
4....................	3/17/40	—	+	+	+		4/21/40	+	+	+	+	+
5....................	4/21/40	+	+	+	+	+						
6....................	3/24/40	—	—				4/21/40	—	—			
7....................	3/ 6/40	—	—				4/15/40	—	—			
8....................	3/ 6/40	—	—				4/15/40	—	—			
9....................	3/ 6/40	—	—				4/15/40	—	+	—		
10....................	3/18/40	+	+	—			4/21/40	—	—			
11....................	3/ 6/40	—	—				Discontinued Use of Well. Pump Broke.					
12....................	3/ 6/40	—	—				4/15/40	—	—			
13....................	3/ 6/40	+	+	—			3/17/40	—	—			
14....................	3/24/40	—	—				4/21/40	—	—			

All of the people became interested in their water supply and wanted it tested. As I collected my samples, some would apologize, "Our water just isn't fitten to drink"; others said, "I think it would be a good idea if the water out here were tested more often." Some intend to have their water sent regularly to the State Health Department. Even if I had not made a single correct test, I have at least accomplished the fact of arousing the people's interest in their health problems and the connection that drinking water may have with their health.

TYPICAL MONTHLY REPORT OF AUSTIN WATER PURIFICATION PLANT

Filtered water pumped:

	1938	1939	1940
Monthly total	172,250,000	205,120,000	242,650,000
Average daily	5,556,000	6,616,774	7,827,419
Maximum daily	6,830,000	7,190,000	9,780,000
Minimum daily	4,200,000	5,898,000	1,723,000

Filter data:

Total wash water used—in gallons	3,530,000
Per cent of total water pumped	1,555
Average number of filters used daily	8.58
Average hours in service daily	16.69
Average time of filter runs between washes—in hours	5.15
Average maximum head loss—in feet	3.85
Average number of filters washed daily	2.58
Average rate of filtration in million gallons per acre per day	127.1

Chemicals added:

Item	No. Total Pounds	Ave. Grains/gal.	Ave. p.p.m.
Lime	181,844	5.26	90.2
Iron	25,900	.75	12.88
Chlorine	2,316	.067	1.15
Ammonia	705	.024	.412

Analytical data:

	Raw	Tap
Bacteria per ml. @ 37 degrees—24 hours	7160	1.2
Total 10 ml. samples showing gas—48 hours	78/87	3/145
Most probable number of E. coli/100 ml.	243	0
Turbidity		
Average	116.71	—
Maximum	700	—
Minimum	25	—
Total Alkalinity	148	53
Normal carbonate alkalinity	27	—
Non-carbonate hardness	23	30
Total hardness	171	83
Average free chlorine—p.p.m.	—	.84

Chemical costs:

Item	Total for month	Per million gallons	Cost
Lime	$ 755.89	3.87	$ 9.75/ton
Iron	313.02	1.47	28.20/ton
Chlorine	43.35	.24	2.48/cwt
Ammonia	116.44	.55	20.50/cwt
Total	1,228.70	5.83	

A WORKING MODEL OF THE AUSTIN WATERWORKS

By Bill Owsley
*Austin High School, Austin**

Because of the large consumption of water in modern cities, the problem of maintaining a municipal water supply has grown to be a highly technical one. The first problem is to secure a supply large enough to furnish water for such emergencies as fire-fighting in addition to the regular standard, usually about 100 gallons per day per person. The first consideration in locating this supply is purity. Austin, like most cities its size, can obtain a sufficient supply only by drawing upon a source which in its natural state is admittedly impure, and means of purification must be put into effect.

I first became interested in these methods when a small boy. My grandfather knew most of the workers in the plant and I usually accompanied him when he visited with them. As I grew older, my studies in school taught me of the chemical processes involved, and my interests grew into the construction of this working model of the Austin plant.

The chief impurities which must be removed from water to make it suitable for domestic use may be grouped into three heads: bacteria, suspended impurities, and dissolved impurities. To test for the bacteria which cause typhoid fever, paratyphoid fever A and B, bacillary dysentery, and for amebic dysentery, the most common diseases carried in contaminated water, a test is run for colon bacilli, usually referred to as *E. coli,* which may have gotten into the water with excreta or sewage. If b. coli, are not present, a safe water is indicated; but their presence indicates a dangerous or at least suspicious water.

Under the heading of suspended impurities, we have first the silt which causes turbidity. Turbidity causes no harm except to render the water murky, but the amount of suspended silt should be cut down to at least 10 and preferably to 5 parts per million to afford a clear, sparkling water. Suspended calcium and magnesium carbonate, bi-carbonate, sulphate, and chloride cause alkalinity, hard water, and the formation of boiler scale. The total amount of suspended solid matter should be cut to 100 p.p.m. or less. Carbonate and bi-carbonate cause alkalinity and have a softening effect. Sodium sulphate causes foaming in steam boilers. If salt is present in quantities over 200 p.p.m., its taste begins to become noticeable.

Under dissolved impurities, iron oxide is very important. It causes a reddish tint in water, a bad taste, hardening of water, and corrosion of metals. It should be cut down to .3 p.p.m. at the most. The gases oxygen, carbon dioxide, and hydrogen sulphide are often

* Presented before the Junior Division of the Texas Academy of Science at the Regional meeting May 4, 1940, at Nacogdoches, receiving the Senior Academy Medal.

dissolved in water, causing odor and metal corrosion. Alkalinity, causing a flat taste, should be lowered to a pH value of between 7 and 9.5.

The chief concern of the Austin plant is to remove the E. coli and the suspended solids present in the water of the Colorado River, the most practical source of water available.

The water is taken in through a revolving screen which removes all large objects such as sticks and leaves. It is then pumped to the mixing basin where slaked lime and ferrous sulphate are added to coagulate suspended matter. The water flows into a tank with a system of baffles where it mixes more thoroughly with the chemicals and partial sedimentation occurs. As the water progresses through this tank, chlorine is added to kill bacteria and ammonia is added to give the water a pleasant taste. Alum is sometimes added in place of ferrous sulphate, and soda ash is used to soften the water at periods when softening becomes necessary. From this process the water goes to another tank with a system of over and under baffles which allows settling and also removes scum and trash which might have come to the surface. After this final precipitation, the water progresses to a sand and gravel filter which removes, by physical means, the last of the sediment. Tests are run for purity and the water then goes to the clear well under the filtration plant to await distribution to the city.

The entire operation, with the exception of the tests run, is automatic, and is known as the continuous method. That is, the water flows slowly from one tank to another as sedimentation takes place, thus having a continuous supply always available. A sample monthly report of the plant is included below, showing amount of water pumped, chemicals added, cost of operation, water analysis, and a comparison of these items with those of previous years.

The chain of lakes along the Colorado River will probably now assure a steady water supply in summer, the usual time of low supply and high demand; and will allow settling of silt before it is taken in for the city's use, thus simplifying the task of the purification plant.

It is well worth any amount of time spent observing it and becoming thoroughly familiar with the procedure. I am glad to have had the opportunity of constructing this model, which I intend to donate to the school.

ACADEMY HANDBOOK

A Compilation of the Legal Documents, Laws, Rules, Regulations, and Instruments Governing the Conduct of Academy Affairs

Compiled, mimeographed, and distributed under the authority of the Constitution and Judiciary Board for the guidance of officers and committees
January, 1940

PREFACE TO FIRST EDITION

During the past three years various officers and committee chairmen have expressed the feeling that the growing complexity of the Academy's activities and the great development of rules and policies regarding the conduct of these activities had made it advisable that there be published a collection of the various regulating articles of the organization. The demand for such publication has steadily become more incessant with time. Until now, officers and committees have depended for their guidance on carbon copies of such articles as pertain to their special field of activities. These copies were sent out from time to time from the office of the Secretary. This has been both expensive to the management of that office and not wholly satisfactory to many of the officers and committee chairmen.

At a meeting of the Constitution and Judiciary Board held in Edinburg in April, 1937, the Board decided to ask the Finance Committee for an appropriation to be used to collect together the material herein included and send copies to all officers and committee chairmen. It was further decided to mimeograph enough copies to supply the requirements of the next three years, and to request all those receiving copies to pay fifty cents for their copy, thus reimbursing the treasury for the expense. It was believed that by the end of three years the development of the Academy's various activities would have so far progressed that experience will have ironed out the discrepancies and ambiguities in this work and amendments and additions to the various regulations will become less common than they are during the present period of rapid development. The material herein can then be printed in booklet form. The Finance Committee allowed the appropriation requested in the preparation of their budget, and, with the acceptance of the budget by the Executive Council, May 22, the Board immediately set about the preparation of this Handbook.

The West Texas Branch of the Academy has been organized and has its proposed By-laws under consideration at present. There is in process of development a College Division, which will probably have a degree of independence, breadth of activity, and character of organization somewhat comparable to that enjoyed at present by the Junior Academy. The foregoing will necessitate additions to this Handbook. To allow each possessor of a copy of the Handbook to keep his copy up-to-date, several blank pages have been added at the end, and, as additional regulatory instruments are drawn or amendments are made to any of the included instruments, the Secretary will mail mimeographed copies which may be pasted in on these blank sheets.

Constitution and Judiciary Board for the Academy Year 1936-37 H. Y. Benedict, E. N. Jones, H. B. Parks, B. C. Tharp, J. C. Godbey, Don O. Baird, Frederick A. Burt, Chairman; W. Armstrong Price, Secretary.

June 10, 1937.

PREFACE TO SECOND EDITION

Due to the large number of amendments and additions to the Articles included in the First Edition of this Handbook which have been necessitated by the expansion of the Academy's activities this revised edition was authorized by the Constitution and Judiciary Board at its regular annual meeting November 9, 1939.

Constitution and Judiciary Board for the Academy Year 1938-39 B. C. Tharp, J. C. Godbey, W. Armstrong Price, F. B. Isely, W. T. Gooch; Don O. Baird, Chairman; Frederick A. Burt, Secretary.

January, 1940.

ARTICLES OF INCORPORATION

The State of Texas
County of Bexar

We, the undersigned resident citizens of the State of Texas, do hereby voluntarily associate ourselves together for the purpose of forming a private corporation for the purposes herein set forth, to-wit:

1.—The name of this corporation shall be "The Texas Academy of Science."

2.—The purposes for which this corporation is formed are: To stimulate scientific research, to promote fraternal relationship among those engaged in scientific work, especially in Texas; to diffuse among the citizens of the State a knowledge of the various departments of science; to investigate and report on any subject of science or industry when called upon by any Department of the State Government; to arrange and prepare for publication such reports of investigation and discussion as set forth in these articles; to collect, arrange, and exhibit articles of scientific worth; to acquire and arrange for use a library of scientific literature; to acquire relics, mementos and articles of scientific interest; to maintain a museum in which these collections shall be available to the Academy and to the public with such restrictions as are placed on similar public institutions.

3.—The place where the principal business of this corporation is to be transacted is in San Antonio, Bexar County, Texas, or such other points as may be deemed expedient by this corporation.

4.—The term for which this corporation is to exist is fifty years.

5.—This corporation shall be managed by a board of five directors. The names and residence of those selected to serve the first year are as follows:

Clyde T. Reed, Kingsville, Texas
C. M. Adkisson, Denton, Texas
J. W. Strecker, Waco, Texas
W. J. McConnell, Denton, Texas
H. B. Parks, San Antonio, Texas

6.—This corporation shall have no capital stock; and it owns no goods, chattels, lands, rights, or credits.

In Witness Whereof we have hereunto subscribed our names on this the 12th day of November, A. D., 1929.

Clyde T. Reed,
C. N. Adkisson,
W. J. McConnell,
J. K. Strecker,
H. B. Parks.

CONSTITUTION OF THE TEXAS ACADEMY OF SCIENCE

(As adopted November 17, 1934, at Austin and amended November 9, 1935, at College Station, November 14, 1936, at San Antonio, November 13, 1937, at Dallas and November 11, 1939, at Austin.)

ARTICLE I

Name

This organization shall be called "The Texas Academy of Science."

ARTICLE II

Object

The purpose of this Academy shall be to stimulate scientific research, to promote fraternal relationship among those engaged in scientific work, especially in Texas; to diffuse among the citizens of the state a knowledge of the various departments of science; to investigate and report on any subject of science, or industry, when called upon by any department of the state government; to arrange and prepare for publication such reports of investigation and discussion as are set forth in these articles.

ARTICLE III

Membership

Section 1.—*Classification:* The membership of this Academy shall be composed of active members (1. Annual; 2. Sustaining; 3. Life), inactive members, fellows, honorary members, patrons, and honorary life fellows.

Section 2.—*Eligibility.* Any person engaged in scientific work or interested in the promotion of science shall be eligible to membership.

Section 3.—*Active Members.* Active members may be: (a) annual members or (b) life members. Annual members may be elected at any regular meeting of the Academy. To become an active member, the candidate shall fill in the application form of the Academy, which, when signed by two members and accompanied by the entrance fee of two dollars (unless he be a member of an affiliated society, or a student enrolled in college, see Art. III, Section 4) shall be sent to the secretary, who shall enroll the applicant as an active member subject to confirmation by election at a regular meeting of the Academy. Any person who shall contribute the sum of five dollars to the Academy annually shall be elected a Sustaining Member, and his dues shall be placed in the General Funds of the Academy. Any person who shall contribute fifty ($50) dollars to the funds of the Academy shall be elected a life member of the Academy, exempt from further annual dues.

All Junior Academy members upon graduation from high school shall automatically become active members in the Academy, without the payment of any fees or dues, for the remainder of the Academy year during which such graduation occurs. Subsequent thereto, annual dues of such members shall be in accord with Article III, Sec. 4.

Section 4.—*Dues.* Every application for membership shall be accompanied by payment of a fee of $2.00, which fee shall constitute the first year's dues, except that in the case of students in college said entrance fee and subsequent annual dues, so long as they retain student status, shall be $1.00.

Section 5.—Members whose annual dues are more than one year in arrears shall be automatically dropped from the organization unless said delinquent member shall request (in writing to the Secretary) that he be retained on the Inactive Rolls.

Section 6.—*Fellows.* Any member of this Academy who is actively engaged in scientific research or the administration of scientific pursuit may be elected a fellow. To become a fellow, the proposed fellow must have held membership in the Academy at least one year prior to his election. He must present to the Academy for permanent file a copy of a publication of merit of which he is the author. When these requirements are met, the Executive Council will present the candidate to the Academy at the Annual Meeting. If he receives two-thirds majority favorable vote at the Annual Meeting, he is declared a fellow. All who were fellows in the former Academy may become fellows upon election to membership in the present Academy. Any fellow of the American Association for the Advancement of Science who is elected to membership in the Texas Academy shall automatically become a fellow of the Academy.

Section 7.—*Honorary Members.* Anyone who has rendered distinguished service to the Academy or to science may be elected an honorary member. This honor carries with it the privilege of attending meetings and of participation in deliberation on the floor, but not of making or seconding motions or of voting.

Section 8.—*Patrons.* Any person who shall at one time contribute five hundred ($500) to the funds of this Academy may be elected a patron, who is a life member of the Academy and free from dues.

Section 9.—*Honorary Life Fellows:* Any fellow of the Academy whom the Council may consider has rendered the Academy distinguished service of a scientific or administrative nature may be elected by the Council an Honorary Life Fellow. Such a fellow shall have all fellowship privileges but be exempt from dues.

ARTICLE IV

Sections

Section 1.—Academy shall be divided into sections according to the major interest of its members. The present division shall be:

Sec. 1—Astronomy, Chemistry, Engineering, Mathematics, Physics
Sec. 2—Agriculture, Botanical Sciences, Medical Sciences, Zoological Sciences
Sec. 3—Anthropology, Education, Historical and Philological Sciences, Psychology, Social and Economic Sciences
Sec. 4—Geography and Geological Sciences

Section 2.—Members may designate the section to which they belong. Fellows shall designate their section. The Executive Council is authorized to make re-divisions of the sections when this need shall arise.

ARTICLE V

Intra-Organizations

Section 1.—*Regional Branches.* The Academy may establish through the Executive Council a regional Branch on vote of the majority of the members of the Academy in good standing residing in the territory within which the Branch is desired, providing such vote was taken at a regular regional meeting of the Academy held within the territory.

Officers of the Regional Branches.—Such Branches shall elect and/or appoint their own officers and committees and make any rules for their government not inconsistent with the Constitution and By-laws of the Academy.

Territory.—The definite territory selected by each Branch within which its membership shall reside will be subject to the approval of the Executive Council. Branches are declared duly established when the Executive Council of the Academy has approved their initial organization and the Constitution and Judiciary Board has approved their By-laws.

Section 2.—*Local Chapters.* The Academy may establish through the Executive Council a local chapter on receipt of a request so to do signed by ten members of the Academy in good standing.

Officers of Local Chapters.—Such Chapters shall appoint their own officers and committees and make any rules for their government not inconsistent with the Constitution and By-laws of the Academy.

Territory.—The place of headquarters and definite territory selected by each chapter within which its membership will reside will be subject to the approval of the Executive Council.

ARTICLE VI

Sub-Organizations

Section 1.—*Junior Texas Academy of Science.* The Texas Academy of Science shall actively promote the organization and operation of science clubs in connection with accredited public and private schools of the State of Texas. These clubs when duly affiliated shall together constitute the Junior Texas Academy of Science which is the Junior Division of the Texas Academy of Science.

Section 2.—*Affiliated Collegiate Science Organization of Texas.* The Texas Academy of Science shall actively promote the organization and operation of science organizations in connection with the colleges and universities of the State of Texas. These organizations when duly affiliated shall together constitute the Collegiate Division of the Texas Academy of Science.

ARTICLE VII

Affiliated Organizations

Section 1.—*Conditions.* Any organization now existing within the state, having a membership of more than ten and an object in organization which meets the approval of the Executive Council of this Academy may become an affiliated organization upon the approval of the Executive Council.

ARTICLE VIII

Executives

Section 1.—*Officers.* The officers of this Academy shall be a President, an Executive Vice-President, a Vice-President for each section, a Secretary, an Assistant Secretary, a Treasurer, an Editor, and a Representative to the American Association for the Advancement of Science. These officers shall perform the duties usually devolving upon such officers in similar associations. All officers of the Academy must be elected from the fellowship.

Section 2.—*Executive Council.* The President, the Vice-Presidents, the Secretary, the Assistant Secretary, the Treasurer, the Editor, the Representative to the American Association for the Advancement of Science, the Chairman of the Collegiate Division Committee, the Chairman of the Junior Academy Committee, and the immediate Past President shall constitute the Executive Council which shall transact any necessary business of the Academy not specifically provided for in this Constitution and may authorize collection of a registration fee in connection with annual meetings. At any meeting of the Executive Council, four members are authorized to transact business, provided that sufficient notice is before sent to all the members of the Executive Council.

The Chairmen of all Boards and of all Permanent Committees and the elected Councilors of Regional Branches which have been regularly established who are not members of the Executive Council shall be Associate Members of the Executive Council with all Council rights except those of making and seconding motions or voting thereon, or of being counted in determining a quorum.

Section 3.—*Board of Directors.* In order that the Texas Academy of Science may comply with the charter granted by the State of Texas and thereby make legal the actions of this body, a board of seven directors (board of trustees) will be chosen at each Annual Meeting. The Board shall consist of the President, the Secretary, the Treasurer, the senior ex-President and three members of the Academy in good standing who shall serve terms of three years each, except that in 1939 one member shall be elected for a term of one, one for two, and one for three years. This Board shall have authority in all the legal relations of the Academy.

Section 4.—*Terms of Office.* All elective or appointive officers, with the exception of the Secretary, the Treasurer, the Editor, and the Representative to the American Association for the Advancement of Science, shall hold office until the succeeding annual meeting. The Secretary and the Editor shall be elected on odd-numbered years for a period of two Academy years. The Treasurer and Representative to the American Association for the Advancement of Science shall be elected for two years on even-numbered years. The Executive Council shall fill by appointment all vacancies that arise.

ARTICLE IX

Constitution and Judiciary Board

Section 1.—The membership of this Board shall consist of all Ex-Presidents and Ex-Secretaries of the Academy who are in good standing and have served a full term each during the past five years, and the President and the Secretary of the Academy.

Section 2.—It shall be the duty of the Board to review all proposed amendments and revisions to this Constitution and to give a written report of their recommendations thereon, together with their reasons for such recommendations, to the session of the Academy at which the proposed amendment or revision is to be acted on. If the Board is divided in its opinion, a minority report must be incorporated as a part of the general report.

Section 3.—It shall also be the duty of this Board to serve as the Court of Judgment on any question of the interpretation of this Constitution, or the constitutionality of any act committed by the Academy or any agent thereof.

ARTICLE X

Committees

Section 1.—*Permanent Committees.* There shall be thirteen permanent committees as follows: 1. Program; 2. Publications; 3. Auditing; 4. Nominations; 5. Affiliations; 6. Junior Academy; 7. Finance; 8. Library; 9. Membership; 10. Regional Meetings; 11. Inactive Members; 12. Research Grants; 13. Collegiate Division.

ARTICLE XI

Amendments

Section 1.—*Amendments.* This Constitution may be amended at the final business session of any Annual Meeting of the Academy by a three-fourths majority of the attending members of at least one year's standing; provided, that no such question of amendment shall be decided on the day of its presentation, and that a report on the amendment by the Constitution and Judiciary Board be presented and read as a part of the discussion on the motion to amend.

BY-LAWS OF THE ACADEMY

(As adopted at College Station, November 9, 1935, amended at San Antonio November 14, 1936, at Dallas November 13, 1937, and at Austin November 11, 1939.)

ARTICLE I

Duties of Officers

Section 1.—The President shall be the chief executive officer of the Academy. He shall serve as a member of the Board of Directors and as chairman of the Executive Council, as a member of the Constitution and Judiciary Board and of the Finance Committee. He shall be an ex-officio member of all committees.

Section 2.—The Executive Vice-President shall serve as vice-chairman of the Executive Council. He shall be chairman of the Regional Meetings Committee. In case of the death or resignation of the President he shall succeed to that office.

Section 3.—The sectional Vice-Presidents are of equal rank. They shall serve as (a) chairmen of the respective sections of the Academy; (b) as members of the Executive Council, and (c) as members of the Regional Meetings Committee. They shall have the authority to appoint (with the approval of the President) sub-chairmen and clerks of their sections for the term of the annual meeting.

Section 4.—The Secretary shall perform the usual duties of that office. He shall act as secretary of the Board of Directors and of the Executive Council, as a member of the Constitution and Judiciary Board and as Chairman of the Committee on Inactive Members. He shall serve as a member of the Regional Meetings, and of the Finance Committees, and the Junior Academy Committee. At each regular meeting of the Academy, he shall submit a report on the activities and conditions of the Academy and shall make regular reports to the Executive Council.

Section 4A.—The Assistant Secretary shall be a member of the Executive Council and of the Membership Committee. He shall serve as Recording Secretary of all Academy meetings and issue certificates of Academy membership and Fellowship. He shall perform such other duties as the Executive Council may from time to time designate.

Section 5.—The Treasurer shall receive and disburse (on order of the Executive Council) all moneys of the Academy the handling of which has not been specifically allocated to some other officer or agency, as custodian. He shall submit his accounts annually to the auditing committee of the Academy and shall render an audited report to the Academy at its annual meeting. He shall serve as a member of the Executive Council, as a member of the Board of Directors, and as chairman of the Finance Committee.

Section 6.—The Editor shall act as chairman of the Publications Committee and shall have charge of the editing and publishing of all Transactions and Proceedings of the Academy and of all other publications not specifically allocated by the Executive Council or the Academy to some other officer, committee or agent.

Section 7.—The Representative to the Council of the American Association for the Advancement of Science shall represent the Academy's interests in that organization and shall keep the Academy informed as to the activities of that organization. He shall have charge of the promotion of cooperation between the two organizations.

ARTICLE II

Meetings

Section 1.—Meetings of the Academy shall be of two classes: (1) Regular meetings and (2) Special meetings. Regular meetings shall be of two types: (a) Annual meetings and (b) Regional meetings.

Section 2.—The time and place of the annual meeting shall be determined by the Executive Council not more than ninety days subsequent to the preceding annual meeting.

Section 3.—Regional meetings shall be held at convenient times and places as decided by the Executive Council.

Section 4.—Special meetings may be called by the Executive Council for the purposes (1) of participation by the Academy in the meetings of some other organization whose aims and purposes are consistent with those of the Academy, or (2) the presentation of a special program by the Academy.

ARTICLE III
Committees

Section 1.—Standing and special committees shall fulfill the services for which they are appointed, or which are called for under the terms of the Academy's Articles of Affiliation and the Constitution and Articles of Policy of the Junior Academy.

Section 2.—Members of Local Arrangements Committee for Regional meetings shall be appointed by the Regional Meetings Committee, except for those Regional meetings held within the jurisdiction of an organized Branch, in which case they shall appoint a Council-Representative. Members of all other special committees shall be appointed by the President.

Section 3.—Members of permanent and standing committees shall be appointed by the President and confirmed by the Executive Council except as such members are provided for by these By-laws.

Section 4.—As provided in these By-laws, the Regional Meetings Committee shall consist of the Executive Vice-President as chairman with the sectional Vice-Presidents and Secretary as members. The Finance Committee shall consist of the Treasurer as chairman with the President and Secretary as members, together with such other members as may be added under (3) above. The Publications Committee shall consist of the Editor as chairman with such other members as may be added under (3) above.

ARTICLE IV
The Junior Texas Academy of Science

Section 1.—The Texas Academy of Science shall actively promote the organization and operation of local science organizations in connection with the accredited public and private schools of the State of Texas. These organizations shall, when duly chartered by the Texas Academy of Science, together constitute the Junior Texas Academy of Science.

Section 2.—Each science organization seeking membership on meeting the Junior Academy requirements, and upon recommendation of the committee in charge, shall receive from the Secretary of the Texas Academy of Science a charter of membership which shall designate it as a chapter of the Junior Texas Academy of Science. This charter shall be valid as long as the chapter shall continue to meet these requirements.

Section 3.—The Executive Council of the Academy shall elect six of a committee of seven members whose terms shall expire two each year for three years, after which each member of the committee shall be elected for a term of three years. This committee, with the addition of the Secretary of the Academy, shall be known as the Junior Academy Committee and shall have full charge of the Junior Academy and its work. This Committee shall formulate the requirements for membership in the Junior Academy, which requirements must be approved by the Executive Council of the Academy.

Section 4.—The officers of the Junior Texas Academy of Science shall be for each organized region: A Regional President, Regional Vice-President, and Regional Secretary-Treasurer. These officers shall be elected for one year at the regional meeting which shall be held in conjunction with the regional meetings of the Texas Academy of Science. The officers, together with the Regional Director, shall constitute the regional executive council of the Junior Texas Academy of Science.

Section 5.—The Junior Academy Committee and the Junior Academy Council shall formulate and agree upon a program of work and the expenditures to be entailed.

Section 6.—A report shall be made by the Junior Academy Committee at each annual meeting of the Academy on the progress and status of the work of the Junior Texas Academy of Science.

ARTICLE V

Affiliated Collegiate Science Organizations of Texas

Section 1.—The Executive Council of the Academy shall elect for terms of three years each, three of a committee of four members, who, together with the Councilor elected by the state organization of the Collegiate Division of the Academy, shall constitute the Collegiate Division Committee, except that in 1937 one member shall be elected for a one-year term, one for a two-year term, and one for a three-year term.

Section 2.—This Committee shall be charged with the duty of supervising and promoting the work of the Division and shall make a report at each annual meeting of the Academy on the progress and status of the Division.

Section 3.—The Councilor shall be a fellow of the Academy and shall be a regularly constituted member of the Executive Council of the Academy.

ARTICLE VI

Procedure at Annual Meetings

Section 1.—The order of procedure at Annual Meetings shall be as follows:

(1) Opening business session
(2) Program sessions
(3) Final business session

Section 2.—The order of business at the opening business session shall be as follows: (1) Call to order; (2) Statements by the President; (3) Reading of proposed amendments to the Constitution; (4) Appointment of special committees; (5) Reading of proposed amendments to the By-laws; (6) Announcements by officers and chairmen; (7) Election of new members. This order of business may be suspended by a majority vote of those present but no business not herein provided for may be transacted at this meeting.

Section 3.—The order of business at the final business session shall shall be as follows: (1) Call to order; (2) Report of the President; (3) Report of the Secretary; (4) Report of the Treasurer; (5) Report of the Auditing Committee; (6) Reports of other officers; (7) Reports of the Executive Council; (8) Reports of standing committees; (9) Reports of special committees; (10) Reading and voting on proposed amendments to the Constitution, including reports of the Constitution and Judiciary Board; (11) Reading and voting on proposed amendments to the By-laws; (12) Unfinished and deferred business; (13) New business; (14) Election of fellows; (15) Election of members; (16) Election of officers; (17) Announcements by the new President and Secretary; (18) Adjournment.

ARTICLE VII

Procedure at Regional Meetings

Section 1.—Only the following items of business may be conducted at regional meetings of the Academy: (1) Hearing, without taking action thereon, of reports of the various Academy officers and committees; (2) Election of new members; (3) Presenting and voting on resolutions concerning the meeting at which presented or the local work of the Academy in the region, provided such resolutions do not involve policies in conflict with the general policies of the Academy; (4) Drafting and voting to present to the Council petitions, resolutions, requests, and suggestions relative to the work of the Academy; (5) Appropriating moneys incident to the expenses of the meeting, providing no appropriations are made whose total is in excess of the total fees and dues collected at the meeting.

ARTICLE VIII

Quorum

Section 1.—Ten per cent of the membership in good standing shall constitute a quorum for the transaction of business at the final business session of the annual meeting.

ARTICLE IX

Amendment

Section 1.—These By-laws may be amended by a majority vote of those present at the final business session of the Annual Meeting, providing the proposed amendment has been presented, read, and laid on the table at a general business session held on the previous day.

RULINGS OF THE CONSTITUTION AND JUDICIARY BOARD

I

Creation of New Sections of the Academy

(Ruling made at College Station, Texas, November 7, 1935)

Article IV (of the Constitution) shall be interpreted as empowering the Executive Council to create a new section, or sections, of the Academy as needs may require.

II

Election and Tenure of Offices in the Junior Academy Committee

(Ruling made at San Antonio, November 12, 1936)

It is the ruling of this Board that the Executive Council has the power to designate annually the officers of the Junior Academy Committee.

III

Authority of the Committee on Inactive Members to Reject Applications of Active Members to Transfer to the Inactive List

(Ruling made at Edinburg, Texas, April 23, 1937)

The Committee on Inactive Members has the right and authority to reject requests for transfer from the active to the inactive list in those cases in which the request does not seem to be based on financial distress with desire to become again active when conditions improve or in which transfer is not for the cause of especial service to the Academy.

IV

Appointment of Regional Director of Junior Division Activities and Granting of Junior Academy Charters

(Ruling made at Dallas, November 11, 1937)

Article IV Section 3 of the By-laws of the Academy shall be interpreted as giving the Junior Academy Committee the power to appoint Regional Directors of Junior Division activities, and to grant charters to such applicants for Junior Academy Chapters as they may approve, subject only to later review by the Executive Council.

BY-LAWS OF THE CONSTITUTION AND JUDICIARY BOARD

(As adopted at Kingsville, April 26, 1935)

The Constitution and Judiciary Board of the Texas Academy of Science having been authorized, its membership permanently established, its duties outlined, and its organization left to its own discretion by Article IX of the Constitution of the Academy as adopted at Austin, November 17, 1934, hereby adopts the following By-laws for its guidance in the transaction of business.

I

Officers

The officers of the Board shall consist of a Chairman and a Secretary. Officers shall be elected each year at the annual meeting of the Board.

II

Meetings

The annual meeting of the Board shall be held in conjunction with the regular annual meeting of the Academy. Special meetings may be held on call of the Chairman.

III

Records

The Secretary shall keep a record of the minutes of all meetings. The original of these minutes is to be kept on file by the Secretary of the *Board* and a copy shall be filed in the office of the Secretary of the *Academy.* Copies shall also be distributed to all members of the Board within two weeks after the close of each meeting. The original shall, before filing in the office of the Secretary, be signed by the Chairman and the Secretary.

IV

Quorum

Four members of the Board shall constitute a quorum for the transaction of business.

V

Amendments

These By-laws may be amended by a two-thirds vote of the members at any annual meeting.

BY-LAWS OF THE BOARD OF DIRECTORS

(As adopted by the Board at San Antonio, January 15, 1938, and amended at San Antonio November 25, 1939)

I

Organization

The provisions for the officers, personnel, and limits of authority of the Board are designated in the Academy's *Articles of Incorporation* Section 5; *Constitution* Article VIII, Section 3; and By-laws Article I, Sections 1, 2, 4 and 5.

II

Records

The Secretary of the Board shall mail a copy of the minutes of each meeting to all members of the Board and a copy to the Chairman of the Auditing Committee within ten days after each Board meeting. The minutes of each Board meeting shall be read, for informational purposes, at the first meeting of the Executive Council after each Board meeting. A copy of the minutes of each meeting shall be incorporated by the Secretary of the Academy in each of his annual reports to the Academy.

A period of thirty days shall be allowed after each Board meeting during which any Board member who was present at the meeting may write the Secretary indicating any apparent error or omission in the minutes. If no such apparent error or omission is so indicated the minutes shall automatically stand approved.

III

Quorum

Four members of the Board in good standing shall constitute a quorum. On all questions the Chairman of the Board is accorded full voting privileges irrespective of the manner of the division of the Board.

IV

Amendments

These By-laws may be amended at any Board meeting by a vote of a majority of all Board members.

ARTICLES OF FINANCIAL POLICY

(Adopted by the Finance Committee at Edinburg, April 23, 1937. Endorsed by the Executive Council at Austin, May 22, 1937. Adopted by the Academy at Dallas, November 13, 1937, and as amended at Austin, November 11, 1939.)

ARTICLE I

General Treasury and Special Funds

Section 1.—All moneys received by the Academy from any source (except the *Special Funds* noted below) shall be placed in the *General Treasury* in the custody of the Treasurer of the Academy and handled by him in accordance with the methods of procedure outlined in this Financial Policy or any amendments thereto.

Section 2.—The Special Funds herewith allowed are those, and only those cases coming under:

(1) *Article III of the Council's Articles of Policy* as adopted at a meeting of the Executive Council at College Station, December 16, 1934, or any amendment thereto.

(2) *Paragraph 6 of the Requirements for Membership of High School Science Organizations in the Junior Texas Academy of Science* as adopted by the Junior Academy Committee at a meeting in Kingsville April 26, 1935, and legalized by the Academy at its annual meeting at College Station, November 9, 1935, under the Academy's By-laws, Article IV, Section 3, or any amendment thereto.

(3) Gifts and Legacies to the Academy for special purposes, which funds shall be held until they may be used for the purposes intended in such form as the Finance Committee approves, provided the aggregate amount of such funds is less than one hundred dollars, but when any such funds shall exceed one hundred dollars the recommendation for their temporary investment shall be approved by the Board of Directors.

ARTICLE II

Classification of Moneys and Investments in the General Treasury

Section 1.—All moneys and investment equivalents belonging to the Academy and placed in the General Treasury (as defined in Article I, Section 1 above) shall be divided into two funds: (1) *Permanent Endowment* and (2) *General Fund.*

Section 2.—All moneys, or investment equivalents, paid by Patrons and Life Members on their election shall be placed in the Permanent Endowment. All moneys or income-producing properties or investments received by gift or legacy shall be placed in the Permanent Endowment, except only such as may have been specified in the gift or legacy for specific purposes.

Section 3.—All moneys received from other sources shall be placed in the General Fund.

ARTICLE III

Investment of Permanent Endowment

Section 1.—The Permanent Endowment Funds shall be kept invested for the production of Academy income in such form as the Executive Council shall approve. Any fractional sums remaining after investment shall be kept at interest in such interest-bearing bank account, building and loan certificates, or postal savings account as the Finance Committee shall approve, except as may be provided in Section 2 of this Article.

Section 2.—The Finance Committee shall be empowered to invest in loans to the General Fund not more than one hundred dollars ($100.00) from the Permanent Endowment for periods not to exceed six months and at the current rate for bank loans on similar amounts.

ARTICLE IV

Duties of the Finance Committee

Section 1.—The Finance Committee shall, during the first thirty days of each Academy year, prepare a budget of prospective income and expense for the ensuing year and present the same to the Executive Council for their action thereon.

Section 2.—The Finance Committee shall keep the Executive Council informed of all funds awaiting investment, of all investments approaching maturity, and of any threatening change of value to any investments, and shall call upon the President of the Academy to call an Executive Council meeting for the consideration of such situations. At such meeting the Finance Committee shall present to the Executive Council such information bearing on the subject as it possesses together with its recommendations thereon.

Section 3.—The Finance Committee shall each year originate and consider plans for the increase of Permanent Endowment Funds and for increasing the income of the General Fund and shall convey to the Executive Council details of such plans as it may approve. The Committee shall also consider such general plans relating to the Academy finances as the President, the Executive Council, or any other official agent of the Academy may refer to it and shall, after analyses of such plans, inform the referring officer or agent of its recommendations.

Section 4.—The Chairman of the Finance Committee shall submit to the annual meeting of the Academy a committee report separate from his report as Treasurer of the Academy. The report of the Finance Committee shall inform the Academy of the condition of the Permanent Endowment and the gross and net income on the same as distinguished from the General Fund and the gross and net income therein.

Section 5.—At the opening of the first meeting of the Finance Committee in each year the committee shall elect (or request the Chairman to appoint) a secretary from among its own members. The secretary shall serve for the Academy year and shall submit a copy of the minutes of each meeting to each member of the Committee and shall file one signed copy with the Chairman of the Committee, one with the Secretary of the Academy, and one with the Chairman of the Auditing Committee.

ARTICLE V

Duties of the Auditing Committee

Section 1.—The Auditing Committee shall each year check the minutes of the Secretary of the Finance Committee. It shall audit the accounts of the Treasurer of the Academy, the custodians of such Special Funds as are provided for in Article I, Section 2, of these Articles, and of any and all officers and committee chairmen of the Academy to whom the annual budget has allotted appropriations. The Chairman shall write a report embodying the Committee's findings and file two copies with the Secretary of the Academy prior to the opening business session of the annual meeting. The Secretary of the Academy shall include one of these copies in the permanent records of the Academy for the year, and shall deliver the other to the Registrar of the annual meeting for purposes of public examination at the registration table.

Section 2.—For purposes of this audit the officers and committee chairmen whose accounts must be audited shall close their books as of date of two weeks prior to the annual meeting and make their accounts and reports available to the Chairman of the Auditing Committee at least one week prior to the annual meeting.

ARTICLE VI

Adoption and Amendment of These Articles

Section 1.—Upon the adoption of these Articles by the Finance Committee, they shall be presented to the Executive Council for its endorsement or amendment. The Executive Council, upon its endorsement, or amendment and endorsement as amended, shall declare them to be in effect for the balance of the Academy year when they shall be presented to the Academy at the opening business session of the annual meeting. Upon adoption, or amendment and adoption as amended, by the Academy at its final business session of the annual meeting, they shall become the permanent financial policy of the Academy.

Section 2.—These Articles of Financial Policy may be amended at any annual meeting of the Academy, provided such amendment is presented at the opening business session of the meeting and brought before the Academy for action at the final business session of the same meeting, provided further, that the recommendations of the Finance Committee on such proposed amendment are presented as part of the discussion on the motion to amend and, further, that the opinion of the Constitution and Judiciary Board that such amendment will not conflict with the Constitution, By-laws, or established policies of the Academy is presented as a part of the discussion on the motion to amend.

PUBLICATION POLICIES

(As formulated by the Publication Committee and adopted by the Council, Sections 1 to 8 adopted at Waco, November 29, 1930. Section 9 adopted at Austin November 16, 1934, and amended at San Antonio, November 14, 1936. Section 10 adopted at College Station, April 14, 1935. Section 11 adopted at San Antonio, November 14, 1936.)

Section 1.—No copyright material will be published unless copyright is owned by the Texas Academy of Science.

Section 2.—When two or more co-authors present a paper it must be in writing and signed by each author separately.

Section 3.—No paper that has been in whole or part printed elsewhere will be accepted for publication.

Section 4.—Papers may be given elsewhere on consent of the author and Publications Committee.

Section 5.—The giving of a paper at an Academy meeting does not insure its printing, however, preference is given to such papers. Only such papers as may be a definite contribution to science or make such knowledge available, are to be printed.

Section 6.—Monographs, anotated lists, floras and faunas and the like are encouraged. These are to be read before the Academy by title or abstract prior to being printed.

Section 7.—Authors of articles wishing to use illustrations must furnish or pay for cuts; these cuts remain their property and will be returned after the printing.

Section 8.—Short articles will be printed and 100 separates furnished to the writer for $2.50 per page (one side of each sheet). Authors of monographs, anotated lists, floras, faunas, and the like for which there will be a sale will underwrite one-half of the printing charge until this charge is paid, then they will receive the money advanced from sales.

Section 9.—Only such material shall be included in the Transactions as has been presented by the author in abstract or in toto, at a regular meeting of the Academy; this to take effect with the publication of Volume 19 (as amended at San Antonio, November 14, 1936).

Section 10.—Any member of an affiliated organization who has read a paper before that organization may submit his paper to the publications committee of the Academy for publication in the Academy's Transactions. If such paper is accepted by the Academy's publications committee, it may be published on payment by the author, or the affiliated organization, of the proportional cost of printing the paper to the cost of the whole volume in which it appears.

Section 11.—Beginning with Volume XX the Proceedings and the Transactions are to be edited, printed, and distributed separately. The proceedings are to be prepared for distribution as shortly after the annual meeting as the Editor is able to print them in a manner satisfactory to the Publications Committee. The Transactions are to follow later in the year.

LIBRARY POLICIES

(Formulated by the Library Committee and submitted by them to the Council at Waco, March 24, 1935, and adopted by said Council on that date.)

Section 1.—Ten coplies of each publication now in possession of the Academy and like number of each publication which the Academy publishes in the future are to be retained in the permanent files of the Academy Library.

Section 2.—One hundred copies of each publication are to be available for exchange purposes with other libraries.

Section 3.—The remaining copies are to be sold, except that a file copy is to be deposited with each of the Secretary, Editor, and Chairman of the Library Committee.

Section 4.—Exchange copies are to be handled by the Chairman of the Library Committee and the sales copies are to be retained and sold by the Secretary.

Section 5.—In case an author wishes to buy publications or reprints they shall be sold to him at the cost of publication. Copies of publications sold to persons other than the author shall be sold at a price to be determined for each publication by the Library Committee. In case anyone wishes to buy as many as fifty of any single publication, they may be sold at a 10% discount from the regular price.

Section 6.—Prices for publications now in the possession of the Academy library have been established.

RESOLUTIONS AFFECTING POLICY AS ADOPTED BY THE ACADEMY AT ANNUAL MEETINGS

I

The annual meetings shall be held every other year (in the even-numbered years) at one of the three central locations in the order named, beginning with Austin in 1934, College Station, Waco. These annual meetings to be alternated with annual meetings held outside these central locations on the odd-numbered years. (Adopted at Waco, November 29, 1930.)

II

(Adopted at Dallas, October 21, 1933.) Resolved that the Academy encourage further study and consideration, as a part of the promotion of scientific study and the advancement of learning, of the possibility of the establishment of a marine biological station.

III

(Adopted at Dallas, October 21, 1933.) Resolved that the Texas Academy of Science place itself at the service of the State Park Board in order to encourage the establishment and maintenance of state parks.

IV

(Adopted at College Station, November 9, 1935.) Be it resolved that——— the following objectives are emphasized. . . . The development of a plan to establish an Annual Academy prize for outstanding research to be awarded at each annual meeting.

V

(Adopted at San Antonio, November 14, 1936.) Resolved, that the Texas Academy of Science favors a wise policy of conservation, one that, while ministering to present needs, will pass our natural resources on to future generations; and that we commend research having this in view.

ARTICLES OF POLICY ESTABLISHED BY THE EXECUTIVE COUNCIL

I

Section 1.—Officers and committee chairmen are allowed to draw from the supply such copies of Proceedings and Transactions as in their judgment they might use in specific cases for promoting the interests of the Academy. (Council meeting, College Station, December 16, 1934.)

II

Section 1.—All funds received from the sale of Proceedings and Transactions shall be turned over to the Treasurer of the Oberholser Committee rather than into the general treasury of the Academy and added to the funds held by said committee against the cancellation of outstanding notes. (Council meeting held at College Station, December 16, 1934.)

III

Section 1.—A list of inactive members shall be maintained in the files of the Secretary and Treasurer upon which list shall be carried the names of any members of the Academy who, while in good standing, shall write to the Academy stating that because of financial reasons they feel unable to pay their dues for the current year, but desire to remain connected with the Academy and its work and be reinstated as an active member when conditions allow. Such inactive members' names shall appear on the regular published list of members without special distinguishing title. Such members may at any time be reinstated on the active list by making payment of dues for the current year of the reinstatement. They shall have no vote in business sessions and be ineligible for office or appointment to permanent committees. Their reception of Academy publications shall be in the discretion of a committee (known as Committee on Inactive Members) composed of the Secretary, Treasurer and Editor. The Committee may, from time to time, at its discretion, transfer to the inactive list active members to whom the Academy may be especially indebted but whose dues are in arrears.

Section 2.—The Committee on Inactive Members is empowered to reinstate on the rolls of the Academy such former members as have been suspended for non-payment of dues, provided request for such reinstatement is made, accompanied by the back dues owing at the time of suspension. (As adopted at College Station, Dec. 16, 1934, and amended and added to Feb. 2, 1936.)

IV

Section 1.—Junior Academy pins shall be of two types: One, gold pins which shall be presented by the Academy as evidences of award on the recommendation of judges appointed at regular meetings of the Academy at which Junior Academy programs are held. Second, silver pins, which may be purchased by any member of the Junior Academy in good standing. The Treasurer shall act as custodian of the die and the pins which are the possession of the Academy. (Adopted at San Antonio, November 14, 1936, and amended at Waco, Feb. 21, 1937.)

V

Section 1.—*Records and finances of regional meetings.*

The finances of the regional meetings shall be handled as follows:

(a) The local committee shall, insofar as possible, meet all expenses of meetings out of local contributions, commissions and meals and rooms, registration fees, and appropriations by chambers of commerce or other organizations sponsoring and promoting local activities.

(b) Any expenses in excess of what can be met by the above methods shall be appropriated by vote of the Academy in its business session in accordance with Article VI, Section 1, Item 5, of the Academy's By-laws and in accordance with the said By-law shall be paid by the Treasurer from the treasury of the Academy.

(c) The chairman of each meeting shall, at the close of the meeting, send to the Treasurer of the Academy all membership fees and dues collected at the meeting, together with the names of the individual members paying such fees or dues.

Section 2.—After the close of each meeting, the chairman of that meeting shall prepare in duplicate, or direct the Secretary of the meeting to prepare in duplicate, a report of the meeting which shall include the minutes of all technical and business sessions, a notice of all social sessions and field trips, and a summarized statement of the meeting's finances. One copy of such report shall be sent to the chairman of the Regional Meetings Committee, and the other copy together with the original registration list, shall be sent to the Secretary of the Academy.

Section 3.—At least three weeks prior to each meeting, the Secretary of the Academy shall furnish the chairman of each regional meeting and each chairman of Local Arrangements with a copy of Article VII of the By-laws of the Academy and with a copy of this article of the Council Articles of Policy. He shall also furnish each such chairman with copies of official membership application blanks. (Council meeting held at Waco, November 28, 1936.)

VI

Colored scientists are permitted to attend meetings of the Texas Academy of Science. (Council meeting at Waco Nov. 10, 1938. This action taken following a precedent established by the Council for the College Station meeting and again for the Dallas meeting.)

POLICIES ESTABLISHED BY CUSTOM

(Many methods of procedure have been tried which have worked so successfully that they have been repeated the following year. Some of them have been used continuously since their first success. These procedures which have been used to advantage without interruption to date for three or more years are here gathered together under the head of Established Policies. They have been established only by the precedence of continual usage and have none of them been adopted by official action.)

I

Drafting of Rules, Regulations and Articles of Policy by Committees and Their Method of Adoption

In 1930 the policy of committees drafting articles of policy dealing with the phases of Academy work coming under their jurisdiction was started by the Publications Committee formulating the first eight articles of our Publications Policy and submitting them to the Council for approval. Since that time the policy has been continued by the formulating of amendments to the Publications Policy by the committee 1934, 1935, and 1936, the formulating of the Library Policy by the Library Committee in 1935, of the Junior Academy Policies by the Junior Academy Committee in 1935, of the Articles of Affiliation by the Affiliations Committee in 1935, of the Regulations Governing Research Grants by the Committee on Research Grants in 1936 and their amendment in 1937, and of the Articles of Financial Policy by the Finance Committee in 1937.

These various Rules, Regulations, and Articles of Policy have been adopted by the committee formulating them and either (1) followed by them as a guide without endorsement, or (2) presented to the Executive Council for endorsement or amendment and endorsement, or (3) submitted to the Academy for endorsement or amendment and endorsement. The disposition under (1), (2) or (3) depended partly on the importance of the policy to the welfare of the Academy and partly on the desirable permanency of the policy.

II

Chairmanship of the Affiliations Committee

On the adoption of the present Constitution the then President of the Academy nominated, and the Executive Council confirmed the nomination, the Representative to the American Association for the Advancement of Science as Chairman of the Affiliations Committee. This policy has since been followed without interruption.

III

Method of Formulating By-Laws and Amendments

At a meeting of the Executive Council November 17, 1934, the Council requested the Constitution and Judiciary Board to formulate a new set of By-laws covering the newly arising needs of the Academy and present them to the Academy for their adoption. The first amendment to these (the present by-laws) changed somewhat the personnel of the Junior Academy Committee and was drafted by the Board at the request of the Junior Academy Committee and was adopted by the Academy November 14, 1936. The next proposed amendment to the By-laws dealt with the organization of the College Student Division and was drafted by the Board on request of the College Student Division Committee.

Thus, the present By-laws and all amendments thereto have been formulated by the Board in accordance with desires expressed for changes by the various boards and committees of the Academy concerned rather than by the board or committee originating the desire for change.

IV

Personnel of Nominating Committee

Following the annual election of 1934, the new President submitted to the Executive Council the names of the Past Presidents to compose the Nominating Committee for the year. This policy has been followed since without interruption.

There has been considerable variation in the method of designating the Chairman of the committee. Three plans have been used: (1) The junior (in point of service) Past-President has been appointed; (2) The senior (in point of service) Past-President has been appointed; (3) The committee has been authorized to elect its own Chairman from among its members.

RULES AND REGULATIONS GOVERNING GRANTS IN AID OF RESEARCH

(Numbers I, II, III adopted by the Committee on Research Grants at College Station June 5, 1936. Numbers IV, V, and VI adopted by the Committee at a meeting at College Station April 17, 1937. Number VII adopted by the Executive Council at a meeting at Edinburg April 17, 1937. Policy through Article VII approved by the Executive Council at Austin May 22, 1937.)

I

The application for a grant shall be accompanied by (1) a statement of the title of the problem; (2) What, if any, progress has already been made on the problem; (3) The scientific record of the applicant; (4) The equipment, apparatus, and supplies for which the grant, if received, will be used.

II

Grants for aid in research shall be made only to members of the Academy who are in good standing.

III

Within a year after the completion of a problem for which a grant was awarded, the Grantee shall present before a regular meeting of the Academy a paper embodying the results of his research, and shall submit to the Editor of the Academy an Abstract of not more than five hundred words for publication in the Proceedings of the Academy.

IV

Grantees shall draw funds as they may need, up to the limit of their grants, from the Treasurer of the Academy on the endorsement of their request for such funds by the Chairman of the Committee, or of some other member of the Committee who has been specially designated by the Chairman to make such endorsement.

V

The title to all permanent equipment or apparatus purchased from funds budgeted to the Committee shall rest permanently in the Academy, but it is expected that such permanent equipment or apparatus shall not be withdrawn from the Grantee so long as he may continue to employ it in pursuit of the problem for which it was assigned, or so long thereafter as he may continue to employ it in research unless it may be needed by the Academy for use on a new grant.

VI

On the completion of the research problem for which a grant was awarded (or three weeks prior to the annual meeting of the Academy if the problem has not been completed) each Grantee shall make to the Chairman of the Committee on Research Grants a signed Progress Report, which report the Chairman of the Committee shall incorporate into his Annual Committee Report.

VII

All permanent equipment or apparatus purchased for use under a research grant shall be receipted for by the Grantee on the following form:

__________________ 19____

I hereby acknowledge receipt from the Texas Academy of Science of the following permanent equipment or apparatus:

____

____

It is understood by me that this equipment or apparatus will be allowed to remain in my charge so long as I may need it in pursuance of the problem for which the grant was made.

Signed______________________

This receipt will then be filed with the Secretary of the Academy before the loan of the equipment or apparatus is completed.

VIII

(Adopted at a meeting of the Committee at Dallas, November 12, 1937.) Amend Article III of these articles by striking out the words *one hundred fifty* and substituting therefor the words *five hundred.*

BY-LAWS OF THE SOUTH TEXAS BRANCH OF THE TEXAS ACADEMY OF SCIENCE

(Approved by the By-laws Committee of the Branch, May 21, 1937, and by the Constitution and Judiciary Board at Dallas, November 11, 1937.)

ARTICLE I
Name

This organization shall be known as the South Texas Branch of the Texas Academy of Science. As such it forms an integral part of the Academy subject to the Constitution, By-laws, Regulations, and Official Acts of the Academy.

ARTICLE II
Membership

The membership of this Branch shall consist of the membership of the Texas Academy of Science (Senior, Junior, and Collegiate Divisions) residing in the area defined by the Executive Council of the Academy as coming under the jurisdiction* of this Branch.

(*The jurisdiction of the Branch was defined by the Executive Council May 22, 1937, as "embracing all that part of the State lying south of a line drawn through Laredo, Alice and Corpus Christi and including those cities.")

ARTICLE III
Meetings

Section 1.—The regular regional meeting of the Academy held within the jurisdiction shall constitute the annual meeting of the Branch, and is hereinafter referred to as the *annual-regional* meeting. At the *annual regional* meeting the *Form of Procedure* for regional meetings as outlined in Article VII of the By-laws of the Academy shall constitute the established form of procedure, Provided: That (2) of said Article VII shall not be interpreted as excluding the election of new members to the Academy who may reside outside the State or in parts of the State not organized into a Branch, and, further, that (3) of said Article shall be interpreted as including the election of Branch officers.

Section 2.—Special meetings may be held on call of the Executive Committee, but no business shall be transacted at such meetings.

ARTICLE IV

Officers

Section 1.—The officers of this Branch shall be a President, a Vice-President, a Secretary, and a Regional Director of Junior Academy Activities. These officers must be members of the Branch in good standing.

Section 2.—The first three of these officers shall be elected by the membership of the Branch for a term of one year at each annual-regional meeting of the Branch. The fourth shall be appointed by the central organization of the Academy from among the members of the Branch in accordance with the regulations governing the appointment of this Director of Activities.

Section. 3.—The President shall be the chief executive officer of the Branch and shall serve as Councilor under the provisions for that officer in the Constitution of the Academy. He shall serve as Chairman of the Executive Committee and as an ex-officio member of all other committees. He shall be Chairman of the business session of the annual-regional meeting and together with the Regional Representative of the Executive Council (appointed under the provisions of Section 2 of Article III of the By-laws of the Academy) shall serve as Co-chairman of all other sessions of the Branch.

Section 4.—The Vice-President shall succeed to the duties of the President in case of death or resignation of that officer. He shall perform the duties of the President at Executive Committee meetings and at meetings of the Branch in the absence of that officer.

Section 5.—The Secretary shall perform the usual duties of that officer and shall act as secretary of the Executive Committee. Each year he shall submit to the annual-regional meeting a report of the activities and conditions of the Branch, and shall file a copy of this report, together with the minutes of all Branch meetings, with the Secretary of the Academy.

Section 6.—The Regional Director of Junior Academy Activities shall perform the duties demanded of them by the central committees of the Academy in charge of this Division.

ARTICLE V

Committees

Section 1.—The officers of the Branch and the Regional Representative of the Executive Council shall constitute an Executive Committee. The Executive Committee shall have authority to plan meetings, fill vacancies in the elective offices (except that of vacancy in the office of President) caused by death, resignation, or removal, and execute the plans of the Branch as expressed in the annual-regional meeting or of the Executive Council of the Academy.

Section 2.—Special committees may be appointed by the President as occasion may require. Such committees shall not function longer than the term of the President appointing them.

ARTICLE VI

Quorum

Ten per cent of the membership of the Branch in good standing shall constitute a quorum for the transaction of business at the annual regional meeting.

ARTICLE VII

Amendments

Section 1.—These By-laws may be amended (under the authority of (3) of Article VII of the By-laws of the Academy) by a majority vote of those present at the business session of the annual-regional meeting, providing the proposed amendment has been presented, read, and laid on the table at a session held on the previous day.

Section 2.—An amendment so made shall be submitted to the Constitution and Judiciary Board of the Academy and shall become effective upon their ruling that it does not conflict with the Constitution, By-laws, Regulations, or Policies of the Academy.

BY-LAWS OF THE WEST TEXAS BRANCH OF THE TEXAS ACADEMY OF SCIENCE

(Approved by the Constitution and Judiciary Board at Dallas, Nov. 11, 1937.)

ARTICLE I

Name

This organization shall be known as the *West Texas* Branch of the Texas Academy of Science. As such it forms an integral part of the Academy subject to the Constitution, By-laws, Regulations, and Official Acts of the Academy.

ARTICLE II

Membership

The membership of this Branch shall consist of the membership of the Texas Academy of Science (Senior, Collegiate, and Junior Divisions) residing in the area defined by the Executive Council as coming under the jurisdiction* of this branch. (* The jurisdiction of this Branch was temporarily agreed upon April 15, 1937, as to consist of the following counties: Brewster, Crockett, Culberson, El Paso, Hudspeth, Irion, Jeff Davis, Pecos, Presidio, Reagan, Reeves, Schleicher, Sutton, Terrell, Tom Green, Upton, and Val Verde.)

ARTICLE III

Meetings

Section 1.—The regular regional meeting of the Academy held in the area shall constitute the annual meeting of the Branch, and is hereinafter referred to as the *annual-regional* meeting. At the Annual-regional meeting the Form of Procedure for regional meetings as outlined in Article VII of the By-laws of the Academy shall constitute the established form of procedure, provided: that (2) of said Article VII shall not be interpreted as excluding the election of new members to the Academy who may reside outside the state or in parts of the state not organized into a Branch; and further, that (3) of said Article shall be interpreted as including the election of Branch officers.

Section 2.—Special meetings may be held on call of the Executive Committee, but no business shall be transacted at such meetings.

ARTICLE IV

Officers

Section 1.—The Officers of this Branch shall be a President, a Vice-President, a Secretary, and a Regional Director of Junior Academy Activities. These officers must be members of the Academy in good standing.

Section 2.—The first three of these officers shall be elected by the membership of the Branch for a term of one year at each annual regional meeting of the Branch. The fourth shall be appointed by the Central Organization of the Academy from among the members of the Branch in accordance with the regulations governing the appointment of this Director of Activities.

Section 3.—The President shall be the principal executive officer of the Branch. He shall serve as Chairman of the Executive Committee and as an ex-officio member of all other committees. He shall be Chairman of the business session of the annual-regional meeting, and, together with the Regional Representative of the Executive Council (appointed under the provisions of Section 2, Article III of the By-laws of the Academy) shall serve as a co-chairman of all other sessions of the Branch.

Section 4.—The Vice-President shall succeed to the duties of the President in case of death or resignation of that officer. He shall perform the duties of the President at meetings of the Executive Committee and at meetings of the Branch in the absence of that officer. He shall serve as Counselor under the provision for that officer in the Constitution of the Academy, and shall be expected to attend at least one meeting of the Executive Council yearly.

Section 5.—The Secretary shall perform the usual duties of that officer, and shall act as secretary of the Executive Committee. Each year he shall submit to the annual-regional meeting a report of the conditions and activities of the Branch, and shall file a copy of this report, together with a copy of the minutes of all Branch meetings, with the Secretary of the Academy.

Section 6.—The Regional Director of Junior Academy Activities shall perform the duties demanded of him by the central committee of the Academy in charge of this Division.

ARTICLE V

Committees

Section 1.—The officers of the Branch and the Regional Representative of the Executive Council shall constitute the Executive Committee. The Executive Committee shall have authority to plan meetings, fill vacancies in the elective offices caused by death and resignation (except that of vacancy in the office of President) and execute the plans of the Branch as expressed in the annual-regional meeting or in the Executive Council of the Academy.

Section 2.—Special committees may be appointed by the President as occasion may require. Such committees shall not function longer than the term of the President appointing them.

ARTICLE VI

Quorum

Ten per cent of the membership in good standing shall constitute a quorum for the transaction of business at the annual-regional meeting.

ARTICLE VII

Amendment

Section 1.—These by-laws may be amended (under the authority of (3) of Article VII of the By-laws of the Academy) by a majority vote of those present at the business session of the annual-regional meeting, provided the proposed amendment has been presented, read, and laid on the table at a session held the previous day.

Section 2.—An amendment so made shall be submitted to the Constitution and Judiciary Board at its next meeting and shall become effective upon their ruling that it does not conflict with the Constitution, By-laws, Regulations, or Policies of the Academy.

CONSTITUTION OF THE COLLEGIATE DIVISION

(Drafted by the Committee on Organization of the Division in the fall of 1937. Approved by the Constitution and Judiciary Board at Dallas, November 11, 1937. Adopted at Austin, November 11, 1939.)

ARTICLE I

Name

This organization shall be known as the Affiliated Collegiate Science Organization of Texas.

ARTICLE II

Purpose

The purpose of this organization shall be to promote scientific interest among the colleges and universities of Texas and to assist the Texas Academy of Science in its program by constituting a division.

ARTICLE III

Membership

Section 1.—Any science club or society in any college or university of Texas, having a membership of ten or more student members, at least five of whom are members of the Texas Academy of Science, shall be eligible to membership.

Section 2.—New members may be elected upon written application at a regular meeting.

ARTICLE IV

Delegates

Section 1.—Each organization shall be allowed one official delegate to the annual meeting for each ten members.

Section 2.—Three-fifths of the membership shall constitute a quorum.

ARTICLE V

Officers

Section 1.—The officers of this organization shall be a President, Vice-President, Secretary, and an elected member of the Collegiate Division Committee.

Section 2.—The officers shall be elected at the regular annual meeting by a majority of the delegates present and shall hold office for one year or until a successor is elected.

Section 3.—The officers shall be elected by ballot from the regularly constituted delegates.

ARTICLE VI

Committees

Section 1.—The following shall be the standing committees: Executive, Membership, Constitution and Judiciary, Nominating.

Section 2.—The officers shall constitute the Executive Committee. The President shall appoint the other committees.

ARTICLE VII

Duties of Officers and Committees

Section 1.—The duties of the President, Vice-President, and Secretary shall be those ordinarily prescribed for such officers.

Section 2.—The Executive Committee shall handle all official matters between annual meetings.

Section 3.—The Membership Committee shall review and present all applications for membership.

Section 4.—The Constitution and Judiciary Committee shall pass on and present amendments and by-laws.

ARTICLE VIII

Meetings

Section 1.—The annual meeting shall be held at the time and place of the annual meeting of the Texas Academy of Science.

Section 2.—The annual meeting shall consist of sectional meetings for papers and reports and a business session for the election of officers and other business.

ARTICLE IX

Amendments

This Constitution may be amended at a regular meeting by a two-thirds (⅔) vote of the delegates attending and voting. Such amendment shall become effective on their approval by the Constitution and Judiciary Board of the Academy.

COLLEGIATE DIVISION REGULATIONS

(As adopted by the Collegiate Division Committee at Huntsville, April 30, 1938, and approved by the Constitution and Judiciary Board at Waco, November 10, 1938.)

Section 1.—The Collegiate Division Committee shall receive applications for Charters of Chapters and shall recommend the granting of Charters to the Executive Committee of the Division. Applications for Charters should be signed by the Sponsor of the Club and be accompanied by a copy of their Constitution and By-laws and a copy of their membership roll on the latter of which it is indicated that five or more of their members are student members of the Academy in good standing.

Section 2.—A Charter shall be issued to each Chapter on its becoming a member of the Division and, on approval of the Executive Committee of the Division, such Charters shall be presented at the Annual meeting.

Section 3.—No fees shall be imposed by the central organization except the annual student fees of one dollar from five members as a minimum number for any club in good standing.

Section 4.—Amendments to the Constitution or By-laws of a Chapter must be submitted to the Collegiate Division Committee for examination and will become effective upon approval by that Committee.

Section 5.—A Chapter will not receive Academy publications by virtue of its Charter but will be dependent on the publications received by its student members.

Section 6.—The members of a Chapter are not by virtue of that membership members of the Texas Academy of Science.

Section 7.—The Executive Committee of the Division is responsible to the Collegiate Division Committee which acknowledges its responsibility in turn to the Executive Council of the Academy.

REQUIREMENTS FOR MEMBERSHIP OF HIGH SCHOOL SCIENCE ORGANIZATIONS IN THE JUNIOR ACADEMY OF SCIENCE

(Adopted by the Junior Academy Committee at Kingsville, April 26, 1935, and legalized through adoption by the Academy of Science By-laws Article IV, Section 3, Part 2.)

1.—The science organization must be extracurricular activity in a standard, completely affiliated junior or senior high school or preparatory school.

2.—At least one member of the Texas Academy of Science must be a sponsor of the organization.

3.—There must be at least (12) active members.

4.—The organization must maintain complete organization and carry on a definite program of work during the year, involving not less than one regular meeting per month, at which meeting there shall be presented a meritorious program by the members of the organization, and any other features of entertainment, inspiration, or instruction that may be provided.

5.—The local chapter shall formulate a constitution and by-laws which does not conflict with the model here appended as outlined by the Texas Academy of Science, or shall adopt the model itself.

6.—The organization must make application for membership in the Texas Junior Academy of Science to the Junior Academy Committee of the Texas Academy; and, upon admission, shall pay a charter fee of Two Dollars ($2.00) and annual dues of Two Dollars ($2.00) per chapter.

MODEL CONSTITUTION FOR CHAPTERS OF THE JUNIOR TEXAS ACADEMY OF SCIENCE

(As adopted by the Junior Academy Committee at Austin, April 9, 1935, and amended by the Committee at Austin, November 10, 1939.)

ARTICLE I

Name, Motto, and Colors

Section 1.—This organization shall be called the ———— ———— Chapter of the Junior Texas Academy of Science.

Section 2.—The motto of the Junior Texas Academy of Science shall be: "Science for Service, Safety, and Pleasure."

Section 3.—The colors of the Junior Texas Academy of Science shall be gold and blue.

ARTICLE II

Purpose

The purpose of this organization shall be to develop the scientific interests of high school students of Texas through: encouragement of individual research; keeping up with current advancements of science; and becoming acquainted with leading scientists and science organizations.

ARTICLE III

Membership

Section 1.—The membership of this organization shall consist of active and honorary members of the science chapters belonging to the Junior Texas Academy of Science.

Section 2.—Any high school (or preparatory school) student interested in science problems is eligible to membership and may be invited to membership in the organization by the Chapter.

Section 3.—Honorary membership may be extended by the Chapter to any person who by reason of his services to the Chapter shows a sincere interest in its work and an appreciation of its purposes.

ARTICLE IV

Officers and Committees

Section 1.—The officers of the chapter shall consist of a President, Vice-President, Secretary, Treasurer, Sergeant-at-Arms, and other additional officers as the chapter may desire.

Section 2.—All officers shall be formally inaugurated into their respective offices by an appropriate ceremony.

Section 3.—There shall be the following committees appointed by the President: Membership Committee; Program Committee; and Examining Committee.

ARTICLE V

Fees, Dues, and Assessments

Section 1.—Each member shall pay an initiation fee before he may be initiated into the chapter.

Section 2.—Each active member shall pay dues each semester as specified in the By-laws, and shall be automatically suspended upon failure to do this within three weeks after the beginning of the semester.

Section 3.—Assessments may be levied as necessary for the maintenance of the chapter.

ARTICLE VI

Meetings and Programs

Section 1.—The chapter shall have at least one regular meeting monthly, and as many called meetings as may be needed.

Section 2.—Programs arranged for the chapter shall be open to members and their guests, and shall not exceed one hour in length unless excursions and special features of the program prevent this.

Section 3.—Business meetings shall be separate from the regular program meetings and are open only to members.

ARTICLE VII

Honors

The Junior Texas Academy shall confer honors upon its members who prove worthy and shall designate these honors with appropriate emblems as described in the By-laws.

ARTICLE VIII

Affiliations

The chapter shall maintain membership with the Texas Academy of Science and may send delegates (20% of active membership) from their membership to such annual or regional meetings of the Texas Academy of Science (Senior) as are conveniently located, and shall pay annually the membership dues of two dollars to the Texas Academy of Science.

ARTICLE IX

Amendments

This constitution may be amended by a two-thirds vote of the members present at any regular meeting, provided that the amendment has been presented to the chapter at a regular meeting previous to its consideration.

MODEL BY-LAWS FOR CHAPTERS OF THE JUNIOR TEXAS ACADEMY OF SCIENCE

(Adopted by the Junior Academy Committee at Austin, April 9, 1935.)

1.—Active membership in the Academy is maintained by prompt payment of dues; regular attendance; active participation on the chapter programs; and sharing the general chapter activity.

2.—A member shall be suspended upon failure to satisfy requirements of By-law No. 1, and shall be permanently dropped from the chapter unless he satisfactorily makes adjustments to correct his omissions within a reasonable time.

3.—The duties of the committees shall be:

A.—*Membership Committee.* Shall prepare a list of students who are eligible for membership and present same to the chapter for its consideration.

B.—*Program Committee.* Shall prepare programs and present same to the sponsor for approval before announcing the same; members to be placed on the program shall be notified by the chairman of the committee at least two weeks in advance; and the program shall be posted and a copy given the secretary before the meeting begins.

C.—*Examining Committee.* This committee shall consist of the chapter sponsor and two members and shall pass upon the ability of applicants to satisfy the requirements for honors conferred by the chapter. The requirements for the honors are:

No. I.—OBSERVER: Insignia—emblazoned with red design.

1.—Pass a satisfactory examination upon "Robert's Rules" of parliamentary procedure or order.

2.—Appear on the chapter program at least three times with credit.

3.—Report on at least one project or experiment including a demonstration and an exhibition of illustrative materials such as diagrams, charts, photographs, collections, etc. (Industrial exhibits, rocks, fossils, star-charts, plants, life-histories, etc.)

4.—Must know the history, purposes, and the systems of oragnization of the Junior Texas Academy of Science and its relation to the Senior Texas Academy of Science.

No. II.—JUNIOR FELLOW: Insignia—emblazoned with blue design.

1.—Must be an Observer.

2.—Must present before an annual or regional meeting a report of his original work; or have entered at least two projects or research contests of state compass.

3.—Have written an article of scientific character that was accepted and published by some paper or magazine other than the school or chapter publication.

4.—Present to the chapter without notes, the purpose of the National Academy of Science, the National Research Council, the American Association for the Advancement of Science, and the National Museum. This should include briefly the organization and the administration of each of these organizations.

4.—The dues of this chapter shall be ———— per semester.

5.—The initiation fee shall be ———— which shall cover the cost of initiation and registration with the state organization and the first semester's regular dues.

6.—The emblem presented to each new member at initiation shall be returned when this member qualifies for an honor, and shall be replaced with the proper insignia to distinguish the newly conferred honor.

7.—Expenditure of chapter funds shall be approved by an Executive Council composed of the officers and the sponsor of the chapter.

8.—All science instructors of the school shall be honorary members of the chapter without election and shall have all the privileges and benefits of the student members except that they shall not serve as official delegates to the Texas Academy of Science or to the Junior Academy meetings and they may not vote.

9.—Duties of officers shall be those usually falling to such officers in regular organizations, and shall include a written report at the expiration of each semester. This report is to be filed with the minutes and records kept by the Secretary.

10.—Special recognition in the form of emblems or awards may be offered by the chapter for competitive projects, essays, and other forms of endeavor provided all the major interests of the chapter are included in such competitive activities.

AGREEMENT ON LIBRARY MANAGEMENT BETWEEN THE TEXAS ACADEMY OF SCIENCE AND THE A. & M. COLLEGE OF TEXAS

(Approved by the President and Library Committee of the A. & M. College, April 6, 1934. Approved by the Council of the Academy, September 30, 1934.)

1.—We (the A. & M. College Library) shall reserve for the Academy the section of the stack room which I have already shown you (the Chairman of the Academy's Library Committee). This will include shelf-space for about nine thousand volumes, as well as five window-alcoves, equipped with desks and chairs. As you already understand, we have closed stacks. This means that only faculty members and graduate students are allowed in the stack-room. While it will of course be impossible to close off your space from the rest of the stacks, your shelves will be plainly labelled, and no interference with them is anticipated.

2.—This Library agrees to handle the lending of your books to members of the Academy who live elsewhere. It is understood that borrowers are to pay postage both ways. Requests for such loans should be addressed to: "Reference Librarian, A. & M. College Library, College Station, Texas," and should state that the maker of the request is a member of the Academy.

3.—This Library agrees to catalogue your collection in our card catalogue, marking each card with the name of the Academy, and keeping also a separate list of your books in card index form.

4.—Books belonging to the Academy are to be loaned to non-members for use outside the building only upon written request from the local library representative of the Academy. This Library may, however, on its own responsibility, permit the use of your books inside the building.

5.—It is understood that this library will not handle exchanges of the publications of the Academy for other publications.

6.—This Library agrees to take the same care of the books of the Academy which is given to its own books. It does not agree, however, to assume responsibility for any losses which may occur.

7.—The Academy agrees to allow this arrangement to be a permanent one until or unless it secures a separate Academy building, in which case, only the Academy may remove its collection from this Library.

This arrangement is intended as a permanent one. In view, however, of the fact that conditions may arise which it is at present impossible to foresee, this Library reserves the right to terminate this arrangement (giving two years' notice) at any time at which the Librarian of this College may consider it desirable to do so.

AFFILIATION AGREEMENT BETWEEN THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE AND THE TEXAS ACADEMY OF SCIENCE

(From Summarized Proceedings of the Association, P. 19, 1926.)

Each affiliated academy has a single representative in the council of the Association, without regard to the number of Association fellows on its roll, and members of these academies not yet enrolled in the Association are at all times eligible to Association membership without payment of the usual entrance fee. Each affiliated academy receives from the Association, to aid in academy work, an annual financial grant, at present amounting to fifty cents for each of its members who is also an Association member in good standing. The association is to arrange with each affiliated academy to name an official Association Representative from outside of the academy region, who is to be present at the annual meeting of the Academy, if such an arrangement is desired by the latter.
(Amendment, from letter of Otis W. Caldwell to the Academy, March 16, 1937.)

"According to motion as passed by the Executive Committee and the Council, the funds (the grant above referred to) would not be available for publication. . . . in the discussions thus far, the Executive Committee has taken the position that the grants should be assigned to individuals for the assistance of their investigations and that since these research grants come from funds that are assigned to research, we do not have the right to use them for publication of annual reports of the academies, etc. . . . sometimes it might help an academy even more for the funds to be used for publication, but at present we have no authority to do that."

TEXAS ACADEMY OF SCIENCE AND AFFILIATED ORGANIZATIONS—ARTICLES OF AFFILIATION

(Adopted by the Council, April 17, 1935, under Authority of Article VII of the Constitution.)

1.—Any organization within the state which has for its principal object the advancement of learning can become affiliated with the Texas Academy of Science by making application for affiliation to the Council of the Academy.

2.—On a favorable vote by the Council of the Academy on application coming under the provisions of (1) the petitioning organization shall be declared to be affiliated and a letter to such effect shall be issued to it by the Academy. Such letter shall bear the seal of the Academy, together with the signatures of its President, Secretary, and Chairman of the Committee on Affiliations.

3.—The Secretary of each affiliated organization shall furnish the Secretary of the Academy a copy of its roll of members and a list of its officers with the addresses of its President and Secretary and the time of its annual meetings, and each year thereafter, during affiliation, shall furnish a revision of this list.

The Secretary of the Academy shall, in turn, furnish the Secretary of the affiliated organization a copy of its roll of members and a list of its officers, revising such list annually.

4.—The affiliation of an organization is in no way to be construed to imply other than a friendly, mutually-helpful relationship between the Academy and its affiliated organizations and among the affiliated organizations themselves. Affliation between organizations under these articles carries with it no loss of complete independence on the part of either of the organizations involved.

5.—The privileges conferred upon affiliated organizations of their members by the Academy are as follows:

A.—Rights and privileges of individual members.

1.—Election to membership in the Academy without the payment of an entrance fee.

2.—The right of any member of an affiliated organization who has read a paper before that organization to submit his paper to the Publications Committee of the Academy for publication in the Academy's Transactions. If such paper is accepted by the Academy's Publications Committee, it may be published by the Academy on payment by the author, or the affiliated organization, of the proportional cost of printing the paper to the cost of the whole volume in which it appears.

3.—The right of members of affiliated organizations to use the circulating library of the Academy on payment of the cost charges of circulating the volumes used by them.

B.—Rights and Privileges of Affiliated Organizations.

1.—The right of an organization to hold any or all of its meetings in conjunction with the annual or regional meetings of the Academy. So far as the organization may desire, these meetings may be held separately or as union meetings, in the latter case providing opportunity for the members of each organization so joining to take advantage of distinguished speakers.

2.—The rights and privileges of co-operative participation in mutual problems as outlined in Article 6.

6.—There shall be established a body known as "*The Conference of the Texas Academy of Science and Its Affiliated Organizations.*" The purpose of this conference shall be to set up a means of co-operation between the various scientific and learned bodies of the state in supporting public and legislative moves affecting scientific work, in fostering good fellowship between the various affiliated bodies, and providing a body for coordinating plans for advancement.

The conference shall meet annually during the annual meeting of the Academy and on call. It shall have the right to establish its own rules of procedure and elect its own officers and committees, and in this the Academy shall have no preference. The membership of the conference shall consist of the President, Secretary, Chairman of the Affiliations Committee of the Academy, and the President, Secretary, and a third member of each affiliated organization shall be appointed or elected by that organization. Presidents and Secretaries of affiliated organizations not present at the annual meeting may be represented by proxy. The representative of the Academy to the Council of the American Association for the Advancement of Science shall be an ex-officio member of the conference.

In the matter of determining cooperation in policy or any inter-organizational matter, no organization shall be bound by the acts of the conference.

BY-LAWS OF THE CONFERENCE OF AFFILIATED SOCIETIES

(As Amended at Waco, November 11, 1938.)

The members of the conference assembled at College Station, November 9, 1935, under the authority of Article VI of the Articles of Affiliation between the Texas Academy of Science and its Affiliated Societies hereby adopt the following regulations for the conduct of such business as the Conference may desire transacted.

I

The officers of the Conference shall be a Chairman, a Vice-Chairman, and a Secretary.

At each annual meeting of the Conference the term of the Chairman shall expire and the Vice-Chairman shall automatically become Chairman for the ensuing year. At each annual meeting the Conference shall elect a Vice-Chairman for one year, and beginning in 1938 every fourth year shall elect a Secretary for the ensuing four-year term.

II

The annual meetings of the Conference shall be held in conjunction with the annual meetings of the Academy.

Special meetings may be called by the Executive Committee as necessary.

III

The Executive Committee shall consist of the officers of the Conference.

The Executive Committee shall be empowered to carry out the plans of the conference as expressed in its meetings and to transact such business as may arise during the recess of the conference.

IV

In accordance with the Articles of Affiliation under which this Conference is held the acts of the conference are directed solely toward the end of cooperation between such of the affiliated societies as may be interested in the policies under consideration and are in no way binding on the organizations represented.

V

In view of the limited powers of the Conference as stated in Article VI of the Articles of Affiliation and in Article IV of these By-laws, no quorum is necessary for the transaction of business except for the election of officers or amending these By-laws.

A quorum for these purposes shall consist of one-fifth of the members of the Conference representing one-third of the societies affiliated.

VI

These By-laws may be amended by a two-thirds vote of the Conference at any annual meeting.

SOCIETIES AFFILIATED WITH THE ACADEMY

Central Texas Section, American Chemical Society
Dallas Astronomical Society
Dallas Nature Study Club
Dallas Ornithological Society
El Paso Archaeological Society
Houston Museum and Scientific Society
North Texas Biological Society
San Antonio Science Club
Texas Archeological and Paleontological Society
Texas Association of Science Teachers
Texas Entomological Society
The Texas Folk-Lore Society
Texas Nature Federation
University Science Club
The Texas Society of College Teachers of Education
West Texas Historical and Scientific Society

STANDING COMMITTEES

Program—O. A. Ullrich, Frederick A. Burt, Hal P. Bybee, W. W. Floyd, W. W. Freeman, F. M. Getzendaner, J. C. Godbey, B. B. Harris, Willis G. Hewatt, Leo T. Murray, Ottys Sanders, Emily Barry Walker.

Publications—Don O. Baird, W. S. Adkins, H. H. Fletcher, J. C. Godbey, H. P. Parks, W. Armstrong Price, Ellen S. Quillin, Gladys H. Baird.

Auditing—Avery Cushing, W. R. Stephens, Douglas R. Semmes.

Nominations—W. T. Gooch, Don O. Baird, J. C. Godbey, F. B. Isely, E. N. Jones, W. Armstrong Price, Cylde T. Reed, B. C. Tharp.

Affiliations—S. W. Bilsing, T. H. Etheridge, Willis G. Hewatt, J. A. Yarbrough.

Junior Academy—Emily Barry Walker (1941), Addison Lee, Secretary-Treasurer (1942), Frederick A. Burt (1941), Addie Millican (1941), Greta Oppe (1942), R. T. Robinson, Velma Wilson.

Finance—Otto O. Watts, E. F. George, Secretary, Frederick A. Burt (1941), F. M. Getzendaner, W. G. Goldsmith, O. A. Ullrich.

Library—S. W. Bilsing, Don O. Baird, Phil Goodman, Ide P. Trotter, Eula Whitehouse.

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of

THE TEXAS ACADEMY OF SCIENCE

1940

VOLUME XXIV

Houston, Texas
Published by the Academy
1941

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THE TEXAS ACADEMY OF SCIENCE

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VOLUME XXIV

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Published by the Academy
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PREFACE

Each paper presented herewith came to the Publications Committee with the approval of the Vice-president of the Section of the Senior Division under whose auspices it was originally given.

The Chairman of the Collegiate Division recommended the publication of the prize winning papers in the contest and the Committee, finding all three of unusual value, regrets that the limitations of space and the cost of essential graphic material, permitted the inclusion herein of only one.

Chairman, Publications Committee.

December 10, 1941.

CONTENTS

The Honorable Miguel Alvarez Acosta, local Mexican Consul, has prepared the paper which I am about to present for your consideration. He has written it in his native tongue, and I have made an effort to convert it into English. However diligent my efforts have been to portray a faithful picture of the original version, you will find, I am sure, that the translation necessarily savors of the Spanish touch, especially in the mode of expression.

I am sure that I have robbed Señor Alvarez Acosta's work of brilliancy in the exposition of facts and theory, since it is common knowledge that Cervantes' language is rich and abundant in ways and means of expressing thought.

I am, at this time, constrained to make a preliminary explanation of the terms "Revolution" and "Socialism."

Revolution, as the term is commonly understood in Mexico, is not used in the sense of a rebellion, but is used to designate a period of its history dating from 1910 to the present time. Therefore, please bear in mind that revolution does not mean internal disorder, but refers to the social phenomenon that began, as I said before, in 1910; became more accentuated in 1917 and is still evolutionizing at the present time.

The words "socialistic education" have no relationship in the remotest sense to communism. It deals with social life in the same manner as the laws in the United States apply to social conduct. W. W. Floyd.

THE EDUCATIONAL AND SOCIAL EVOLUTION OF MEXICO

The Texas Academy of Science could not have chosen a more appropriate subject for my talk than the one it has so graciously assigned me: "The Educational and Social Evolution of Mexico." There is a great truth in it and to a certain degree a favorable pre-concept to believe that the social evolution of Mexico has run the same course as the educational evolution and that they have been adjacent, coherent and parallel. On emitting the initial explanation on the subject, I should state that all evolution of government, of masses, of industry and economy is a social phenomenon, although it may bear a certain regressive, stationary or reactionary trend; in Mexico our present state of unquestionable educational progress has been a resultant of the Revolution.

Our social evolution has had as a subject of speculation, of study, and as a matter of legislation, the great masses. We had always believed that although our country is rich, very rich by the spontaneous grant of nature, the richness of its soil cannot be compared with the richness comprised by its peoples; we believe, therefore, that the aggrandizement and betterment of our great masses and of our majorities is the only means of converting nature as an agent of civilization. In some chapter of Social-geography this principle has been set that the nations that have progressed with firm, steady and enduring pace have been those that have utilized the human factor to make of a hostile nature an allied nature. The barrier of the mountain, of the forest and of the river should be converted into a fountain of usefulness; of the river that obstructs to a river that conveys; of the ocean that isolates to an ocean that unites; of a forest that isolates to a forest that provides the elements of life to make the lives of society possible; and the mountain that obstructs to one from which springs the powerful water-fall to turn the wheels of industry, and the mineral potentiality that formerly lay wasted and inert is converted into useful mineral reserve.

On believing, therefore, that the happiness of the nations has been established upon the culture and education of its great masses, we have set up two great schools; the schools of the citizens amid their dual characteristics of farm laborers and city laborers, and the lecture-hall for children. The first school extends throughout the country; it has as its best text the legislation and its teachings; the state has been the teacher, a state that is the exclusive product of the people, and that fulfills its duty by constituting itself, not only in administering to the collective welfare, but in teaching the generations that have passed already the scholastic age, and that now attend the daily school of life.

The present educational status in Mexico cannot easily be understood without comparing the condition of education in Mexico before the revolutionary factor came to change completely, its course, its goal and its methods. It is also true that to grasp a clear idea of the problem concerning the educational movement in our own country, it is well to say, also, that in several occasions we have had to suffer the consequences of inertia, in which the potentialities of reform, impelled by the largely thwarted desire of our people, has gone by means of its own generatrix power beyond the limits marked by the logical plan previously described. Regulations, systems and practices, or rather, the teachers arrived at the point of translating the spirit of our legislation with a personal sectarian judgment; but these are exceptions of which very frequently the enemies of the Revolution have taken advantage to call the revolutionary pedagogy a failure, taking the exception for a rule.

It is convenient to comprise a period that goes no further than the present century; reduce the speculative phenomenon to a contemporaneous era. Those who have classified the educational movement in Mexico with a furiously anticlerical point of view indicate these epochs: (1) Religious education, (2) Laic education, (3) Rational education (Not constitutional) and (4) Socialistic education. Those who have made this classification have concentrated upon taking the measure and form of education, in every epoch because of the intervention the clergy has had in it. The purists, the pedagogues have classified it in another manner, taking as a fountain of said classification, as psychological phenomenon, and thus have divided it into: Didactic school and educative school; that is, a school that teaches and a school that educates; general characteristics: teachings, education. Within the educative school are pointed out eras in which definite systems have prevailed, (School of action, systems of projects, coeducational school, socialized school, etc.).

In my estimation, only two great fields should be formulated primarily: Pre-revolutionary school and Revolutionary school. The characteristics of the former:

> In the first cycles, reading, writing and arithmetic. Religion.
> In the secondary cycles up to the sixth year, teachings (direct aim). Memorization of: Geography, History, Geometry, Social Studies, Urbanity, Religion, etc. These were prepared under a strict memory preponderance, and the child did not learn except what he was taught; his spirit of exploration was never aroused; the pupil was dependent on the teacher. This period is known among the teachers with a title that comprises a whole great cycle — School of Lancaster. The bright child was given the charge of monitor, assistant instructor, and the latter, who was the best product of that education, was a precocious child, a reproduction of an adult in mere infancy; in short, an excellent student, an abnormal student. When we see people today who received that type of education, and that have magnificently adapted themselves to life and is problems, there is no one that can deny the fact that they were products of personal persistence, autodidactic, but never products of that type of teaching.

The originators of the revolution in educational material in Mexico were Rebsamen, Castellano, Parra, Barreda y Torres Quintero; not forgetting Professors Kiel, Justo Sierra y Carrillo and several others whose names it would be tedious to enumerate. The modifications and pedagogical reforms have been felt with major intensity and major detail in the cities. In the country, the school problem has suffered changes of great social consequences, but of minor pedagogical importance. It would not be pleasing to the great teachers of Universal pedagogy, obviously, the systems, form, and technique of our rural schools. That is the reason the Rural School is more of a social phenomenon than pedagogical.

Anyone that may wish to glance over the last few years of the past century and over the first two or three of the present will be convinced that in those times called "Times of Dictatorship," there was no educational institution that (not even in the minutest form at least) guaranteed the education of the children of rural districts. Education did not go further than the towns, the villages, or the hamlets; and even in the hamlets there were seldom cases in which all the children had opportunities of learning to read and write. The families of certain importance in these villages would get together to pay a schoolmaster and, as a general rule, the contributing families were those of the apothecary, the lawyer, the principal merchants, the bookkeeper, the landholders, the families of the officials of the place, and some under the protection of the curate; (in those times the best references were given by the bishops and priests; remember the biography of Juarez). If this occurred in the small towns, one can imagine what happened in the farms, in the congregations, and even in the remote spots where the Indians had been frightened away. Very frequently is heard among the Mexican laborers who came to the United States before 1900: "Sir, I wish that my son may learn to read and write, even though I did not have a chance to learn." Today this concept in Mexico cannot be mentioned without deceiving, because the school that before was for definite castes, for definite elements, is today for everybody, and opportunity is given not only for the student of school age but the Revolution has stressed importance on the night schools for adults as much as on the vocational schools, including the unions of technical and professional improvement, as well as the Workers' University and various other centers of culture.

The educational revolution in Mexico, initiated on general terms, to change the old trend of teaching for a new trend of education, became apparent in the reforms imposed upon each of the educative fields. The basic texts of education were The Spelling Book of San Miguel and The Catechism by Ripalda. The old spelling book, or system of teaching by the name of the letters and the formation of syllables was supplanted by the system of sounds; in fact, the children who learned to read and write with the spelling book, had to suffer the torture of construing, knowing that the name of the letter was, double r (erre) and its phonic meaning single r (r); one of the greatest measures given in subject matter of writing—reading was the change of phonetic value of the letters; they ceased to be called by their names and the alphabet was made of sounds; the letters were enunciated by their phonic meaning exclusively, and not by their former name of the alphabet. Thus, the pupils did not learn the letters by their common name until they could read perfectly and could identify each sound by its name, now without fear that this would obstruct the teaching. The popular method that is still used in Mexico to teach reading and writing is the Phonetic-*Onomatopeic*-System by Don Gregorio Torres Quintero. Phonetic because in it were used the letters by their phonetic value and onomatopeic because to teach them were used sounds taken from nature (objects, animals, persons). The "g" was the sound of one who gargles; the "f" the bellow of a threatened cat; the "u" the whistle of the train; the "j" the pant of a tired man, and etc.

The most serious obstacle that the public education in Mexico has had to overcome, has been the indigenous element; we have in Mexico an immense variety of sub-races, families, and indigenous tribes that the civilization has gradually assimilated, but who have required a superhuman effort to conquer barriers so difficult of overcoming, as customs, the language, and, even religion. In the Indian communities, it has been imperative to use at times native teachers because numerous ancestral prejudices are concealed in each of these ethnic groups; we never have wanted to renounce that valuable element of our population; it forms, in the first place, a high percentage and in the second place, the indigenous type has characteristics worthy of becoming useful, to form with them, a generation that will realize the evolutionary plan of Mexico.

We have seen that the native children are tenacious; of vivacious intelligence, of rapid perception and of a deep spirit of sacrifice; the artistic marvels, that the conquerors found on their arrival to this continent, had been of a totally indigenous product, absolutely aborigines, and we try to reflourish all these attributes that thousands of years ago made a brilliant culture; we are striving to remove the veil of fear and apprehension, that the conquest left among these races that, having populated the great valleys before, remained secluded, for fear afterward in the mountains. In one word we have wanted to introduce the civilization to the indigenous sector; we have taken the school to the mountain and that is the phenomenon really, the transcendental movement of the revolution; have faith in the Indian and recuperate him for the good of the country.

I have been endeavoring especially to bring about some explanation as to the procedures and methods used in teaching reading and writing; because the basic problem of Mexico in the educational field is an extensive one; Mexico is more interested in reducing illiteracy than in producing professionals; the professionals and the technician are products of the social school; necessity forms them and they don't require tactics to guide a sensitive mind; a procedure that never affects the man and that is of a null pedagogical quality; on the other hand, with the children, it is necessary to use the best methods and to look for the program of educational action best suitable to the Indian; for this reason the subject of reading and writing has interested us most.

Just as the social phenomenon has been of urban origin, so it has happened with the technical school in Mexico.

For this reason it has been said that the rural school is the best evidence of the educational service to the masses; and that it has more importance as a social phenomenon rather than as an educational speculation; in the city it was possible to proceed carefully, but beyond the city the methods used tended to be less elaborate, but efficient. Consequently, it has been stated that it was necessary to make education in the rural areas extensive and the urban communities intensive; less elaborate for the great numbers, and in the city a more thorough and complete education.

The social structure of Mexico, especially our own temperament, has compelled us to solve our problems without waiting for ideal conditions in order to solve them. If we had waited to have a perfect teachers' personnel in order to meet the educational needs of the rural pupil, perhaps we never would have approached the solution of the problem. Besides, it would have been undesirable to have sent generations of educators with technical education, desirous for educational research and versed in languages, to rural communities. We started to teach with the resources that we possessed; a bamboo hut, a blackboard and rustic furniture made by the peasant, the teacher and the pupil. The teacher was poorly prepared but well acquainted with the needs of the community. Now we have good schools, adequate equipment, proper methods and good teachers.

Therefore, experience and research have convinced us definitely to establish two well defined schools; the urban school and the rural, and in between the two, the village school.

Outside of the country schools, outside of the private schools supported by two or three rich persons, so that a schoolmaster without the least knowledge of pedagogical methods would teach the children of the well-to-do families, there was nothing that satisfied the necessity of these poor people. Thereupon, the teachers of the wealthy children, taught first religion and urbanity; afterwards they taught them to read in an affected manner, and to recite from books of geography, civics, geometry, etc. The products of this type of teaching were conceited youths of extremely courteous manners and pulchritude and that, though at the same time that they could recite geometry backwards and forwards, they could not calculate the extent of a piece of land; they made magnificent dissertations on geography describing the trains of France, but were absolutely incapable of making a trip to Toluca, Guadalajara, Veracruz, or Mexico City alone. This was what the Method of Lancaster and others already revolutionary produced till a decade later.

If it is true that the reforms introduced in the city schools were transcendental and of great importance, the real triumph of the revolution, the greatest accomplishment favorable to the people was the Rural School. More important than the pedagogical methods, the revolution of methods and doctrines was the consideration of the forgotten sector; bring down from the mountain the natives so that they could enter the social conglomeration and receive the fruits of the Revolution by means of the schools; but it was difficult to succeed in this, for there was not sufficient sincerity to inculcate faith in those who had suffered since the conquest and who had accustomed themselves to see strangers with apprehension. Therefore, instead of the Indian coming down, the school went up to the mountains — a simple school with a minimum of knowledge, but with a great purpose: to create confidence among the frightened indigenous masses.

Would it be audacious to state that the creation of the Autonomous Department of Indigenous Affairs was a justified precipitation, a fruit of enthusiasm and redemption obtained by means of the rural schools? No, this is, obviously, the truth. The public land, the financing, the sanitary measures, the methods of cultivation, etc., reached the Indian by virtue of the previous work of cooperation of the rural schoolmaster.

The rural schoolmaster did not convey perfect methods of teaching. He went to stimulate the approach not only of the Indian, but also the humble classes, the farm laborer; he went to reduce illiteracy, to acquaint the Indian with his community, state, country, with the revolution and his program, but especially to inculcate in him faith. Therefore, later the rural schoolmaster received a specialized preparation; he was taught a little about teaching technique; he learned how to cure certain local sufferings, or to prevent them; he learned to vaccinate, to apply injections, quinine preventives for malarial regions; to filter water; to classify lands; to attack plagues; to form domestic cooperatives; to outline small roads, warehouses, and draining of water dams; in other words, he was taught to show the natives and inhabitants in a small degree what the revolution achieved with the contribution of the rural teacher. The schoolmaster entered the homes of the community, became counsellor; in short, he occupied the place that before, belonged only to the parish priest, but without forcing the peasant to believe in a certain religion, nor to pay taxes to support the clergy, nor to renounce with a cowardly spirit the riches of the earth so as to attain the heaven of the good found in that religious sentence: "Blessed are the poor in spirit for theirs is the kingdom of heaven."

We could compare the normal teacher of first class with a well of science whose water needed all the whole of the civilization from the city to be extracted. A knowledge of chemistry which required retorts for its experiments; physics which required apparatuses; study of biology which required microscopes, slides, dissecting knives; singing with a piano; a gymnasium with all the modern advantages of physical education. Outside of these elements, the city schoolmaster could not transfer his training, as outside of the chord, cube or dams of water, the wells, whirlpools cannot produce their liquid. The rural schoolmaster came to be an enormous multiplication of small running surfacing streams on virgin soil, without the necessity of cube and chord, but immediately usable; he had to use the means nature offered him; he made test-tubes out of vegetable tubes, gymnasiums out of the elements of nature; of the forests, the fields for practical surveying. In short, all elements possible to convey his teachings. He was the fighter who, in the most difficult conditions, paved the way to the secondary school, to the popular arts and industries, to the high school with a spirit that was met several times with risks and threats; this happened then and is still happening in certain regions. The rural schoolmaster, thus, can be recognized as the pioneer of our popular national education.

Clamours have not failed to point out the rural schoolmaster as a sower of restlessness and a creator of difficult situations for the schools in Mexico; but these clamours are, obviously, the same ones that have been obstructing the progress of the school toward the community; the elements which exploited the farm laborer and which played an important part in perpetuating their ignorant state. They began to call them enemies of religion, evil preachers, and accused them as enemies of God, fanatic elements victimizing the rural teachers. There were some that slashed the ears off the schoolmasters in the name of Christ the King. Savage deeds as these were advised by the fanatics, or by those that due to the explanations of the rural teacher, could no longer rent the image of the Virgin during droughts so she would perform the miracle of bringing down the rain. Thus, we can see that the schoolmaster went to disperse gross ignorance, but met with terrible obstacles in the reduced rural communities. The humble people have believed subconsciously; there are passages in our history that rest upon religious values; the brave and charitable deed of the Monks who came to Tenoxtitlan with the conquerors has an undeniable value that has rooted itself on the people and even on the governments; to us, the history of Mexico rests on decided actions of several religious persons; the initiator of our Independence was Hidalgo, who was a priest; Morelos, Matamoros, Torres, also priests and many others. This plus all the preponderance that all the governments of the past century gave the clergy venerable importance in the administrative and legal ranks respected by the humble people, by the choice of the people, besides the power they had on earth, they were divine help. You can imagine by what great prejudices the rural schoolmaster who tried to fulfill his duty was surrounded; the fact alone that he refused to teach officially religion was sufficient reason for the chaplain of the hamlet to rise against him. Then came the undesirable reaction. The revolutionary elements increased their strength and then the defense of the interests of that revolution became bloody and tenacious, but in the eyes of the ancestral fanaticism, everybody seemed to be enemies of the school. The schoolmasters, isolated with problems of their communities, began to be oriented by the Ministry of Education. Cultural missions came to take charge of all the country's practical teachings for the inhabitants and true institutions of perfecting rural schoolmasters. Up until that time rural schoolmasters had sprung up from among the youths who had just completed their elementary instruction; young men who had not the necessary preparation for the difficult task of teaching, but who had assimilated to the elementary of this task with the help of the missions and the regional meetings of pedagogical cooperation of the institution. The rural schoolmasters of each district met and there gave each other pedagogical theories; a program of interchanging experiences was planned and problems that the rural educator experienced in each locality was discussed.

How was this chain of obstacles broken up, that the middle social classes of Mexico, product of a series of retarded governments, had created? It has been said that the co-relation between the educational progress in Mexico and its social evolution is connective, intimate, and this can be proved by showing that the school itself, with the effort of the teachers and the Department of Public Education, would have been insufficient. This is a plain fact. The effort alone of the schoolmaster in the school-hall could not conquer the common enemy, the militant desire of perpetuating ignorance among the masses. The agrarian problem had continued its difficult path, always visible from school. The schoolmaster had met with the opposition of the chapel, and the bar; the agrarian problem had before it a powerful enemy, apparently invincible, the land-holder, the one who had exploited the peasants like peons with miserable wages. He had excellent horses, beautiful buildings in the heart of the farm; but the peons lived in the most miserable huts in a detestable promiscuity. All that budget of misery, of that standard of living, from twenty-five cents daily, the remnant had sprouted wealthy industries of whose profits the legitimate producer was always ignored. And the revolution had to go against the elements that obstructed the delivery of justice to the farm laborers; it succeeded entering the convictions of the peons who at times, frightened by the landholder, withdrew their petitions for land, saying they had sufficient to live on. But the formation of the commissary, the constitution of groups that had strong collective support, came to promote what in the conscience of the people had slowly encouraged the rural schoolmaster, and then he did not feel alone, for he had guardians and protectors among the same peasants and the agrarian problem and the rural educational problem turned to meet on an absolutely cooperative basis.

I have been talking to you about the beginning of this great struggle, an action full of failures and obstacles with rudimentary technical knowledge, with teachers taken at random. Then came the congruent plan, the conscientious platform, elaborated and meditated. At that time the candidate of the revolution to the presidency of Mexico was General Cardenas in the year nineteen hundred and thirty-three in the City of Queretaro which held the Political Social Convention in which the P.N.R. would elect the candidate and would approve of the general program of government; at that time the six-year plan was adopted.

The statistics of that time showed the existence of 40,000 population with an average of 100 inhabitants in which, the function of a rudimentary school, was indispensable, and 16,000 nuclei by an average of four hundred inhabitants. In total, 56,000 communities needed rural schools. The six-year plan approved a maximum effort of opening in three 2-year terms, twelve thousand rural schools, establishing more normal rural schools, increasing the salaries of the teachers. The general motive of education was also approved then, which up till then had been laic, changing it toward the socialistic trend.

This was a reform that caused a great deal of anxiety and alarm among the stationary element of our country; what the Revolution did was to inform the pupil by means of acquainting him with the social plan that Mexico followed, teaching him what his country was. The country was wakening up; the socialistic education was very far from being what several people of foreign countries imagined and what ingenious parents believed to have ruined the beliefs of their children. Credit should be given to the administration of General Cardenas, who has distinguished himself for his absolute respect to all religious beliefs, and also the clergy itself, which convinced that President Cardenas only desired to carry through an elevated task without interest in attacking the clergy, ceased its opposition and in various occasions had gestures of solidarity and cooperation with the Federal Government. In the beginning the criticisms were almost childish, even by persons who pretended to be well informed on educational subjects in Mexico. Someone spread the news that throughout the country, in the rural schools the children were forced to insult the images, and to declare that God did not exist. Legends were invented with the object of creating opposition to the new school and perhaps isolated sins that, like the faults of the Christian Chaplain, cannot be attributed to the doctrines nor to the system.

ACTUAL SITUATION OF THE EDUCATION IN MEXICO IN DIFFERENT FIELDS

The special units that we need to mention on which later statistics will be referred are the following:

Rural schools — Suburban schools — Urban schools, divided into elementary grades; primary superior, and primary type. (These last form one single type.) Schools for children of the Army, for the children of Soldiers or Orphans of those who died in military service, Home Schools for children of working women, Vocational Schools, Schools of Arts and Crafts, Night schools for Adults, Secondary schools, Schools for the Indians, Institutions for the Indians, Regional Rural Schools, Educational Industrial Centers, Pre-Vocational Schools, Reformatory Schools, Deaf, Dumb and Blind Schools.

Pertaining to college education, besides the state universities, there are high schools teaching preparatory courses for the different fields that are open in Mexico. In the Capital there are opened secondary schools and in the fields of higher learning: Law, Medicine, Engineering, Teachers' Normal Training, Banking and Commercial. These are a few fields, but at the present date they have multiplied in various branches. The specialized courses in Law, such as Lawyer in Economics, Agrarian Law, Industrial Law, etc. In the field of Medicine, the School of Homeopathy is permitted to function, but the one which has been recognized as the official school is the National School of Medicine. In the field of engineering there is a great variety; from the National School of Architects, Agricultural Engineers, Mining Engineers, Electrical Mechanics, to specialized ones in different branches of the modern industry. It has been asserted in the Educational field that the basic, fundamental, vital factor of the education in Mexico is the rural schoolmaster; but this does not mean that the education in Mexico is only rural; on the contrary, the education as popular phenomenon acknowledges this preponderance of the extensive education, without forgetting the category of its scientific studies, professional specializations, and of its fountains of investigations each time more numerous and each time more serious and profound. In no other way can we explain that we have learned the truth of our national evils. There are towns that from the time that they make it a purpose to learn of their sufferings, till the time when they find out what ailment they suffer, take several years and we, a people who apparently have been endowed only with riches, but that together with the oil and the fertility of the soil, have to inherit the fruits of covetousness and ambition of possessing lands without cultivating them, we, who receive a tropic like the land of Aladdin and in it find the same terrible malarias and the contaminated waters wherein are hidden the amoeba and other patogen microbes.

We, who understand all this, can explain the meaning of the most known picture in the United States of the Mexican; that of a man wrapped in a blanket, sleeping under a palm tree and with a big straw hat down to his ears. At times those that paint these pictures do not know the underlying causes that this cold and lazy one from the tropical "Banana Country" has behaved as he does. A man would hardly be wrapped up under a palm tree as the palm tree is from the tropics and the blanket used only when it is cold. No, everything is perfect; that image is real, precise and exact. That man is one who suffers from tropical malaria and becomes drowsy with cold in a temperature of 40 degrees Centigrade in the shade. It is a man that suffers all this in the midst of a country that is rich and that is beautiful. Frequently, when this man is given a medical examination, he is found free from any tropical malaria, yet he is languished, always lax, and does not have the desire to work — the easiest diagnosis is to term him lazy. The solution to the problem should not be the easiest, but the one that would solve the problem. These men, Lic. Zapata Vela, who was born in the tropics of the State of Veracruz, told me, always suffer from a terrible pre-malaria, something not exactly malaria, but rather a charcteristic of the hot tropical regions. Consequently, the education must triumph in the Nahoa, Huastec, Totonac, Tecpanec Indians, for example, not only the influence of custom, language and religion, but the barbaric effect of the tropical climate must be overcome. For this reason we have been compelled to speed up our secondary studies in order to acquaint ourselves with our resources and with the manner by which we can solve our problems. We have endeavored to establish a diagnosis of our national evils in order to eliminate the causes that prevent our growth and development.

To accomplish this it has been necessary to improve our secondary, vocational, professional and technical schools, and even in the field of teaching we have undertaken basic studies of our scholastic population. There have been scientific studies in regard to the characteristic of the Indian child and of the popular arts. The Departments of Psychology of Education and School Sanitation have made worth-while studies, but due to lack of time their findings will not be mentioned at this time; nevertheless, they have found facts pertaining to the physiological, mental and temperamental behavior of our children.

Numerous others have been written on the ethnical, economic, psychic, and social status of the Indian.

For a period extending over several years the Department of Public Education has endeavored to improve its methods and its scope of work. In order to do justice to the work of this dependency of the executive, a lecture of several hours would be necessary. Let it suffice to state that this department has exerted equal zeal and interest to the elimination of illiteracy that has prevailed among great masses of our people, as well as to the urban and rural instructional needs, as to the highest manifestations of our culture as being cultivated in the Department of Fine Arts (ballet, choirs, orchestras, typical music, symphony orchestras, art, dramatics, painting and sculpture, etc.).

Another lecture would likewise be necessary in order to present the work done in regional schools for the Indians, of the work done in the country school and in the school for children of the soldiers. As a matter of fact, each one of these subjects would require a general plan of approach such as origin, forerunners, program, important aspects, reforms, norms of achievements, results and future plans, etc. This would cover, as mentioned above, a longer lecture than the lecture now being presented.

For the present I have endeavored to present to you in a chronological outline what education has achieved, what it has recently achieved, and what it can achieve in the future. It would use the methods that have proved successful at present and with the great purpose of making out of our children, not men and women that would blaspheme the priest, and who would take the name of God in vain, or that would antagonize the capitalist and the contractor, but that would learn to live and cooperate for the welfare of the nation, and to create a spirit of friendliness and good will toward other nations. When the children, men and women embrace this human ideal, we can rest assured that we have made a happier country, without exaggeration, a mother country with greater opportunities to overcome the suffering of the individual through peace, security and the happiness that come from a happy, intelligent Mexican family.

One of the determining causes in the backwardness of our schools during the early revolutionary period, was the multiplicity of methods pursued. However, once the important reforms of the Rural School were put into effect, the public schools in the city and towns, and even the private schools, became autonomous.

At present the State and the Federal Government have under their absolute control the education of the whole country. The activities of the Federal and State school authorities are so planned that there is no conflict between them in the educational field.

In the individual States of Mexico, the highest officer is the Director General of Education; he is considered as a Department Head of the State and confers personally with the Governor in matters of increasing the number of schools, personnel, salaries, changes in school system, school material, etc. Said official controls all the schools located throughout the State; in order to carry out his work efficiently, the State is divided into zones and each zone is under the supervision of a school inspector. The Inspector must have been Director of a high school for at least five years; a Director needs to have been principal of an elementary school for at least two years and the principal in turn, needs to have had long experience as a teacher.

The Inspectors must visit their jurisdictions and make a monthly report to the Department. The statistics must show the number of pupils attending, the progress made, the work done in the school, and in the community. The Department of Education on receipt of these reports remedies the deficiencies noted.

In each State there is also a Federal Director General of Education, but he as well as the one from the State are under the absolute control of the Department of Public Education in Mexico City. In other words, the education is centralized in the Federal Government.

In each State there are quite a number of Federal school inspectors; they have under their charge the guidance and regulation of rural education. All rural teachers depend directly from the Federal Government.

At present, our main problem deals with the great masses. Our territory is so large and is not thickly populated. Our people are desiminated in the mountains, in the valleys, in isolated regions, located quite far from centers of civilization, even from small villages. That is why the progress we are now making is gauged by the fact that illiteracy has decreased 20 per cent in the last three years.

However, school attendance in tropical regions is determined by the quality of the water, the extinction of plagues, etc. That is why education in Mexico is a consequence of the social development and general outline of the Government. We must increase the number of dams, our highways, our sanitary brigades, agricultural activities, etc.

Insofar as socialistic teaching is concerned, nothing has been done except to follow the ancient truth: that neither children, youths nor adults can live outside of the social community, outside of the community to which they belong. As a result a child today feels satisfied to be the son of a farmer, a carpenter, a chauffeur, etc., because they have been taught to respect all labor which is honorable and efficient.

Thus we have tried to create a family less divided; with the least amount of hate toward each other, less indifference. This unity could only be accomplished through federal control. We believe there can be no happiness where the humiliation of a fellow being is practiced, merely because he has less money or has a plain, simple unostentatious family tree.

SCOMBRIFORMES, NEW, RARE, OR LITTLE KNOWN IN TEXAS WATERS WITH NOTES ON THEIR NATURAL HISTORY OR DISTRIBUTION

By J. L. Baughman, Houston

The marine fauna of the state of Texas has been much neglected by ichthyologists. Evermann and Kendall (1894) conducted a short survey in which fifty-one families, comprising 137 genera and 230 species were tabulated. One hundred and twenty of these species were fresh water forms, ten were taken in both fresh and salt water, and one hundred were marine or brackish in their habitat.

At the time this survey was made, little data was accumulated on the larger and more active pelagic species. These authors listed only five species of elasmobranchs, although so far as we know there are over thirty, some of which are of extreme interest from a distributional standpoint, being, so far as can be determined at present, identical with species found on the Pacific coast of Panama, and on the west coast of Africa.

Few species of scombriformes were known. Stephenson (1889) lists the Spanish mackerel, *Scomberomorus maculatus* (Mitchill), and Collins and Smith (1892) give figures for the commercial catch of this species, as do Higgins and Lord (1926). Girard (1859) listed some of the carangids, and Breder (1929) lists several species from this coast, but any perusal of the literature at once makes apparent the fact that no one has ever made any consistent effort to study these forms in Texas waters.

There are, so far as it is possible to determine at present, 11 families, representing 26 genera, and 34 species. Of these, several have not hitherto been reported from this coast. Four others were first reported by Baughman (1940). A number of the species, among which may be listed pompano, kingfish and Spanish mackerel, are of value from an economic standpoint, furnishing either food or sport to thousands of Texans; while still others, such as the marlins, sailfishes and tunas merit investigation, for if plentiful they might well form the basis for important industries in the state.

No attempt has been made in this paper to redescribe the species, as the author feels that this has been adequately done, but in one or two instances apparent differences from type have been pointed out as perhaps deserving a more thorough study than has been possible so far. Considerable data have been accumulated in regard to the distribution of the various species, as well as a little material on their natural history, and this is presented, along with a short bibliography, in the hope that interest in further investigation may be stimulated.

The author wishes to express his sincere thanks to Dr. Asa C. Chandler and Miss Alice Dean of Rice Institute for the facilities afforded him for study. Dr. Carl L. Hubbs of Michigan has been most kind, as have Miss Francesca LaMonte and Mr. John T. Nichols of the American Museum, Dr. Lionel A. Walford, of the U. S. Bureau of Fisheries, Dr. Charles M. Breder, Jr., of the New York Aquarium, and Dr. Leonard P. Schultz, of the Smithsonian Institution. He is also indebted to Mr. Gordon Gunter, Marine Biologist of the Texas Game, Fish and Oyster Commission, for a number of specimens and for much valuable advice.

Series: Scombriformes

Family: Acanthocybiidae

Genus: Acanthocybium Gill.

Species: *Acanthocybium solandri* (Cuvier and Valenciennes): *Guahu, Wahoo* (U. S.), *Guarapucu, Peto* (Bahamas), *Queenfish* (Caribbean), *Springer* (Brazil), *Ono* (Hawaii).

Tropical seas; reported from Cuba, Florida, the Bahamas and Brazil. The Pacific form, which is at present considered identical with that of the Atlantic, has been reported from Lower California, Cocos Island, Japan, the Philippines, northern South America and Panama, the Paumotus, Hervey and Loo Choo Islands. Jordan and Evermann (1903) report it from Hawaii, and it is said to be common in the markets of Honolulu, the largest specimen known, one of 106 pounds, having been caught in those waters. Not hitherto reported from the Western Gulf of Mexico, Meek and Hildebrand (1923) basing their description on a skin from Key West, while Evermann and Marsh (1900) make no mention of this form, nor does Gudger (1929). However, in a letter from Mr. William P. Cochran, American consul at Vera Cruz, he states that they frequently catch petoes, "which are apparently a sort of large Spanish mackerel." The common name for *Scomberomorus maculatus* on that coast is macrela, and this seems to be applied to both *maculatus* and *S. regalis* indiscriminately, as are also the names sierra and pintado, while the name applied to *S. cavalla* is sierra, cero, or cavalla. Consequently there is a good possibility that Mr. Cochran's peto is *A. solandri.* This remains to be proven, however.

Known in Texas from Freeport and from Port Isabel, where a number of specimens have been taken.

The measurements for the Freeport specimen were as follows:

Overall length	44 inches
Standard length	1036 mm.
Snout to angle of jaw	137 mm.
Snout to posterior edge of opercle	252 mm.
Snout to anterior margin of orbit	125 mm.
Eye	26 mm.
Interorbital	60 mm.
Snout to anterior insertion first dorsal	285 mm.
Snout to anterior insertion second dorsal	— mm.
Length of pectoral	100 mm.
Longest ray of caudal	139 mm.
Greatest depth of body	144 mm.
Depth of caudal peduncle	32 mm.
Dorsal	25
Second dorsal	12
Pectoral	23

Ventrals	6/6
Anal	12
Finlets	10/10
Upper teeth	54/53

Present throughout the summer.

Family: Cybiidae

Genus: Sierra Fowler.

Species: *Scomberomorus cavalla* (Cuvier): *Kingfish, sierra, cavalla, cero, king.*

Tropical Atlantic in the open sea, coming in immense numbers to the Florida keys and ranging south to Africa and Brazil (Jordan and Evermann, 1896). Reported from as far north as Wood's Hole, Massachusetts. Evidently common throughout the West Indies, off both coasts of Florida, and the shores of Mississippi and Alabama, but does not seem to frequent the Louisiana littoral to any extent, probably because of the great turbidity of the water on most of that coast.

Common off the Texas coast during the summer, frequenting reefs at Port Arthur (Sabine Bank), Galveston (Heald Bank) and various reefs at Freeport. Not reported except casually from Baker, Hospital or Aransas reefs at Port Aransas, but is probably found there and on similar reefs at Port Isabel and along the northeastern coast of Tamaulipas. Reported by the Servicio de Pesca as being present off this, Vera Cruz and Tabasco provinces, and as far south as Campeche, Yucatan, and the Territory of Quintana Roo. Mr. Martinez, of Merida, Yucatan, informs me that this fish is present in those waters throughout the entire year, considerable difficulty being occasioned the Mexican coastal patrols by fast sailing Cuban fishermen, who fish for them without permits, as they are much in demand in the Cuban markets. Mr. E. J. Hofius, of Belize, British Honduras, says he believes that their fish are the same, but is not certain.

The earliest appearance on the Texas coast during 1938-1940 was at Freeport, on April 8, 1938. The same day in 1939 one was caught. May 2, 1940, one was reported from four miles offshore at Port Aransas. The heavy run started at Port Isabel on May 14, 1940, and on June 3 a school estimated to cover a square mile was reported from the same area.

Fish caught on June 2 were full of spawn, not quite ripe, but so far it has not been possible to obtain specimens throughout the season. No immature fish have been taken, the average being from 24 inches to 30 inches in length, and 5 or 6 pounds in weight, although towards the latter part of the year larger fish are apt to be caught.

Mr. John T. Connell, who operates a fleet of charter boats out of Gulfport, Mississippi, and who for many years has kept records of our Gulf fishes, believes there are two runs, one up the west coast of Florida, which follows the coast towards Texas; the other originating in the region of the Yucatan peninsula and following the west coast of the Gulf, but having no connection with the Florida run. This is conjecture, but probably not far out. Mr. Connell believes that the kingfish spawn off Yucatan, and it is possible that some of them do, but there are great numbers of them on this coast in breeding condition. The great proportion of the Texas catch consists of females very nearly in spawning condition early in June, and while they appear to be migratory along most of our coast, the schools keeping to the open sea, at Galveston, Freeport and Port Arthur they congregate in such huge numbers about the reefs that thousands may be caught in a single day by the charter boat fleet. In contradiction to Schroeder (1924) who states that large kingfish are taken from muddy water close to shore, the Texas fish are a clean water fish; so much so that it is practically useless to look for them where the water is even slightly turgid.

There is some variation in measurement between the fish of this coast and the type, Texas fish being characterized by greater depth of body. Further study may prove that this is due to distension of the body by the ova.

The meat is rather dark and somewhat drier than Spanish mackerel, which it resembles. It is fairly palatable, however, especially when baked with some sort of sauce.

Present on the Texas coast during the entire summer.

Genus: Scomberomorus Lacépède.

Species: *Scomberomorus maculatus* (Mitchill): *Spanish mackerel, Spaniard, Spotted cybium, Bay mackerel, Spotted mackerel, pintado, sierra.*

Cape Ann to Brazil, Gulf of Mexico, West Indies. Richardson (1836) remarks that this fish frequents the east coast as high as Cape Cod, while Earll (1883) mentions a doubtful occurrence in the Gulf of St. Lawrence. Also reported on the Pacific coast from the Cortez Banks to the Galapagos. Curiously enough it has never been reported from Cuba (Jordan, Evermann and Clark 1930). Reported from Tamaulipas, Vera Cruz and Tabasco provinces of Mexico; also Yucatan, Campeche and the Territory of Quintana Roo.

Migratory on the Texas coast, first appearing about Easter. In 1940 Galveston reported it on March 9, while Port Aransas 200 miles farther south, did not report it until March 26. The spring run began at Galveston on April 14, 1940. A few appear to remain almost the entire year in Texas waters, as the 1940 report of the Texas Game, Fish and Oyster Commission lists them as having been caught in every month except January, February and March.

Despite the fact that the catch is fairly constant during the season given by Earll (1880) as the breeding season on the east coast, it has never been the good fortune of this writer to take either specimens with spawn, or immature specimens, one of eight inches, taken in the surf on Galveston Island on June 2, 1940, being the smallest. They are sometimes taken in shrimp trawls, also.

A specimen examined by Dr. Leonard P. Schultz of the Smithsonian presented some difference from type, inasmuch as the tooth count is thirty for one side of the upper jaw against the normal count of 11 to 25. Meek and Hildebrand state (1923) that the tooth count of this species is extremely variable, but their highest count of fifty for the upper jaw is still less than that of the specimen in question.

Species: *Scomberomorus regalis* (Bloch): "These fish," says Bloch, "are called by the Dutch in the Indies, *Conings-visch* and *Magelange conings-visch;* by the French *Tazard* and *Tassard;* by the English the *Kingfish;* by the Germans *Königs-fisch;* the Tamules of Tranquebar call them *Wollramin;* and in Ceylon they are called *Aracola.*" Evidently the name *king-fish* was a favorite, as it survives even to this day. *King mackerel, sierra* and *pintado* are also in use, the latter probably arising from the spotting on the sides.

Tropical seas, reported from Massachusetts to Brazil, and said to be very abundant about Cuba. Hubbs (1936) reports this species from the mouth of the Rio Champoton in Campeche, where he took four, varying in length from 36 to 50 mm. Barbour and Cole record it from Progreso, also in Yucatan.

Included here on the authority of Burr (1932) and of Reed (1941). The Mexican Servicio de Pesca report it from off the coast of Tamaulipas, Vera Cruz, Tabasco, Yucatan, and the territory of Quintana Roo.

Hubbs specimens from the Rio Champoton were immature, measuring from 36 mm. to 50 mm., but presenting marked enough characteristics to allow identification. Prior to reaching this size, however, Hildebrand and Cable (1937) state that it is not possible to differentiate between the immature forms of this and those of the two other closely related species, *S. maculatus* and *S. cavalla.*

Consequently Hubbs identification is most interesting, forming as it does the only positive description of fry of this species. His statement that they came from the mouth of the river is also of interest, indicating their presence in brackish or semi-brackish water, a habitat which would be most unusual for the adult.

Family: Katsuwonidae

Genus: Euthynnus Lütken.

Species: *Euthynnus alleteratus* (Rafinesque): *Little tunny, bonito.*

Warm seas, especially Gulf Stream, and as far east as the Mediterranean.

Included here on the authority of Reed (1941) who gives no locality. Also listed by the Servicio de Pesca from Tamaulipas.

Family: Thunnidae

Genus: Sarda Cuvier.

Species: *Sarda sarda* (Bloch): *Bonito.*

This, one of the most abundant of the mackerel-like fishes, is impartially distributed throughout the tropical waters of the Atlantic. On the American coast it has twice been reported from as far north as Nova Scotia, in Canada (Vladykov and MacKenzie 1935). Hildebrand and Schroeder (1928) remark that there are no definite West Indian, South or Central American records. However, Von Ihering (1897) reports it from Brazil, Ribiero (1918) also records it, and Fowler (1917) records it from the Argentine, probably at Buenos Aires. Reported from Trinidad, where it is sold in the markets (Fowler 1915), and from Spain, where metamorphic and larval stages are reported as very abundant in the south, in both Spanish and Moroccan waters, Buen (1930) having conducted rather an extended study of their chromogenesis, while Fowler (1936) gives an extended list of occurrences on the West African coast.

This fish is an early spring and summer visitor to the Texas coast, though a few appear to remain until the fall. It occurs in huge schools, at times covering large stretches of water.

The first bonitoes for 1940 were reported from Port Isabel on April 20, and there was a heavy run along the entire coast between the tenth and thirty-first of May, large numbers being taken at Freeport, Port Aransas, Galveston, and Port Arthur.

Genus: Parathunnus Kishinouye.

Species: *Parathunnus atlanticus* (Lesson): *Black-finned tuna, large-eyed tuna.*

Known from the coast of Florida, Bermuda, Haiti, Martinique, Santa Lucia, Union, Grenada and Tobago Islands, and Trinidad.

Reported by Baughman (1940) as probably *T. thynnus.* The positive identification of the species was based on an excellent photograph of a specimen caught at Port Isabel, and was made by Mr. John T. Nichols of the American Museum and by Mr. John Tee Van of the Tropical Research Department of the New York Zoological Society.

As this fish has hitherto been reported only from Bermuda and the West Indies this is an extension of its range almost eight hundred miles to the west, and the first mention of tuna of any species in the waters of Texas. These tuna are known from only one locality, i.e., Port Isabel, where Mr. Stewart Adkins of San Benito, Texas, advises me that he has seen great schools of them. The species, according to Mowbray, grows to a weight of sixty pounds.

Genus: Neothunnus Kishinouye.

Species: *Neothunnus argentivittatus* (Cuvier and Valenciennes), *Yellow-finned tuna, yellow-fin.*

Known from Scotland (?), Portugal, Angola, Canaries, Madeira, Bermuda, Florida, Martinique, St. Lucia and St. Helena.

Included here on the strength of a rather unsatisfactory sight record, there seems to be need for a great deal further investigation before the species can be definitely placed in the fauna of the state. Certainly on the basis of their food demands these waters are suited to them, there being large quantities of squilla, trigger fishes, both *Balistes vetula* and *Balistes carolinensis,* and the flying fish *Dannichthys rondeletti,* any of which should form an acceptable meal for the species.

Family: Trichiuridae

Genus: Trichiurus Linnaeus.

Species: *Trichiurus lepturus* (Linnaeus): *Scabbard fish, cutlass fish, silver eel, silver fish, savola, hairy tail.*

Warm seas of the Atlantic. Has been reported from as far north as Norway; common in the West Indies and south to Brazil.

Goode (1884) remarks that about Pensacola, where this fish reaches a length of two to two and one-half feet, it is considered fine eating and is eagerly sought by the natives, and that in Jamaica it was assiduously fished for, as many as ninety boats being engaged in the fishery at one time. Specimens taken in Chesapeake Bay in May were apparently ready to spawn.

On this coast there are great concentrations of these fish in the Calcasieu Lake and river system, at Cameron, Louisiana, and large numbers of them all along the Texas coast, Old River at Freeport having many of them at times, especially in the cooler months. Numerous examples of all sizes are taken in shrimp trawls as well as by hook and line. No use is made of them for food.

Family: Istiophoridae

Genus: Istiophorus Lacépède.

Species: *Istiophorus americanus* (Cuvier and Valenciennes): *Sail, sailfish, spikefish, boohoo, guebucu, voilier, aguja voladora, aguja prieta, sea snipe,* etc., etc.

THE MEASUREMENTS

Place Taken........	**I Galveston**	**II Freeport**	**III Galveston**	**IV Galveston**	**V Freeport**
Weight.............	....	17.5 ozs.	....	....	8 lb. 4 ozs.
Overall length.......	638 mm.	782 mm.	952.5 mm.	1028 mm.	1244 mm.
Standard length.....	543 mm.	....	849.5 mm.	851 mm.	1073 mm.
Head..............	233 mm.	248 mm.	314 mm.	324 mm.	401 mm.
Bill, to anterior margin orbit..........	175 mm.	178 mm.	228.5 mm.	232 mm.	300 mm.
Length lower jaw....	82 mm.*	95 mm.	116 mm.	118 mm.	150 mm.
Diameter orbit......	16 mm.	19 mm.	22 mm.	23 mm.	23 mm(?) Damaged
Interorbital.........	18 mm.	22 mm.	28 mm.	27 mm.	41 mm.
Greatest depth......	61 mm.	76 mm.	90 mm.	89 mm.	142 mm.
Greatest thickness of body.............	28 mm.	38 mm.	38 mm.	39 mm.	51 mm.
Dorsal:					
Length base.......	257 mm.	318.5 mm.	406 mm.	435 mm.	530 mm.
No rays...........	43	42†	45	44	42
Longest rays......	....	15 and 16	17 and 18	18 and 19	18 and 19
Second dorsal:					
Length base.......	....	....	....	39 mm.	49 mm.
No. rays..........	....	....	7	7	7
Pectoral:					
Length...........	35 plus	41 mm.	70 mm.	68 mm.	121 mm.
Position..........	Left	....	Right	Right	Left
No. Rays.........	17 or 18	....	20 (approx.)	20	18 or 19
Length ventral filament..........	144 mm.	171.5 mm.	204 mm.	Gone	260 mm.
Anal:					
Length base.......	35 mm.	....	50 mm.	62 mm.‡	88 mm.
No. rays..........	....	....	11	11	11
Length longest ray.	....	....	....	58 mm.	75 mm.
Second anal:					
Length base.......	29 mm.	....	34 mm.	34 mm.	49 mm.
No. rays..........	....	....	7	7	7
Caudal:					
Length upper lobe.	103 mm.	....	197 mm.	190.5 mm.	246 mm.
Length lower lobe..	109 mm.	....	195 mm.	174.5 mm.	242 mm.

* Tip broken, approximate measurement. † In very bad condition, impossible to be certain. ‡ Approximate, in bad condition.

Brazil, West Indies and warmer parts of the Atlantic, north to France, and Devon, England, range extending well down the west coast of Africa, at least as far as Dakar and Goree. Recorded by Baughman (1914) from Belize, British Honduras, the Campeche Banks and Mobile, Alabama. Common on the entire Texas coast, although fewer appearances at Port Arthur than elsewhere.

Thirteen stomachs that were examined by Mr. Stewart Adkins, of San Benito, Texas, contained a large proportion of shrimp, as well as remains of fishes.

Six very small examples have been taken on this coast, three at Galveston, two at Freeport, and one at Aransas Pass. This last was taken on August 31, 1941. This specimen, although not examined, was apparently the smallest of the six, as measurement was given as twenty inches in overall length.

In five other specimens the number of rays in the dorsal varied from 39 to 43, as follows: 39-40 plus-43-43-44, and two sails which were examined separately from the fish contained respectively 39 and 40 rays. These were adults, and in somewhat better shape than most of the immature specimens listed above, as these small fish had been held so long before being brought to the taxidermist that the scales had begun to slip, and in some cases the sails had been damaged by careless handling. All the above measurements are from casts, mounted with the original skins.

The following measurements of three adult fish were very kindly sent me by Mr. Gordon Gunter.

SEX*	I ♀	II ♀	III ♂
Standard length............	1791 mm.	2082 mm.	1676 mm.
Head.....................	609 mm.	....	....
Bill:			
To anterior margin orbit...	432 mm.	....	430 mm.
To base Premax..........	....	508 mm.	526 mm.
Lower jaw:			
To base Premax..........	235 mm.	267 mm.	228 mm.
Diam. orbit...............	38 mm.	44.5 mm.	35 mm.
Depth.....................	260 mm.	318 mm. (Right back of head)	195 mm.
Dorsal:			
Length base.............	755 mm.	990 mm.	812 mm.
No. rays.................	37	38	41
Longest ray.............	784 mm. (16th)	610 mm. (18th)	508 mm. (18th)
Second dorsal:			
Length base.............	76 mm.	80 mm.	70 mm.
No. rays.................	7	7	7
Length...................	152 mm.	165 mm.	139 mm.
Pectoral:			
No. rays.................	19	19 (Rt.)	19 (Left)
Length...................	235 mm.	305 mm.	228 mm.
Ventral filament:			
Length...................	438 mm.	406 mm.	448 mm.
No. rays.................	....	3 and stub.	3 and stub.
Anal:			
Length base.............	121 mm.	155 mm.	95 mm.
No. rays.................	9+	10	8
Length...................	138 mm.	171 mm.	140 mm.
Second anal:			
Length base.............	64 mm.	76 mm.	82 mm.
No. rays.................	7	7	7
Length...................	124 mm.	152 mm.	120 mm.
Caudal:			
Length upper lobe........	368 mm.	457 mm.	394 mm.
No. rays.................	11	11	13
Length lower lobe........	356 mm.	412 mm.	356 mm.
No. rays.................	10	9	11

* Sex is given according to statements by taxidermist, who prepared fish for mounting.

The male is the only one which shows any variation in the ray count of the second anal. The second dorsal count does not vary in any of the specimens noted, although the dorsal count continues to exhibit a good deal of variation.

Genus: Makaira Lacépède.

Species: *Makaira ampla ampla* (Poey): *Marlin, Blue Marlin, spearfish, aguja de castra.*

Common about Cuba and the Bahamas, frequent as far north as North Carolina. Not rare on the east coast of Florida. Supposed to be taken on the Campeche Banks of Yucatan, although this statement needs verification. Doubtful sight record from Belize, British Honduras.

Fishermen from the snapper boats operating out of Texas ports along the Mexican coast are constantly reporting this or some other form of large spearfish.

In Texas the capture of these fish has so far been limited to the area about Port Isabel, lying roughly between the fifty and hundred fathom curves, and extending north and south for about seventy-five miles. Four fish have been taken, the largest weighing 360 pounds and the smallest, six feet six inches in length weighing seventy-four pounds. The greatest concentration of these fish, according to Mr. Stewart Adkin, of San Benito, seems to be between two snapper banks near the hundred fathom line, and two of the fish which he examined had been feeding on red snapper. (Lutianus spp.)

Several fish of this species are reported to have been hooked about 45 miles east of Aransas Pass, in the deep water between Baker and Aransas reefs.

Identification of the fish was made by Mr. John T. Nichols and Miss Francesca LaMonte of the American Museum.

Species: *Makaira albida* (Poey): *White marlin, skillygoelle.*

North along the Atlantic coast, common in Florida and off Ocean City, Maryland, where it concentrates over a series of reefs.

Numerous sight records only, being reported from Port Isabel, where a number have been hooked but none landed. Also reported from Port Aransas, where a supposed specimen was taken in 1939; unfortunately it was not preserved for examination.

Family: Coryphaenidae

Genus: Coryphaena Linnaeus.

Species: *Coryphaena hippurus* (Linnaeus): *Dolphin, dourade, dorado.*

Distribution, world wide, throughout temperate and tropical seas. Common in the waters off the Texas coast, and so reported by Baughman (1941). Gudger (1932) called attention to a heavy concentration of these fish off the Carolina coast, attributing their presence, by inference, to the abundance of flying fish in those waters. In Texas waters this theory does not seem to be tenable. During the six days from May 25 to May 30, inclusive, in 1939, 1430 dolphin were taken at Freeport, Texas, by seven boats. At the same time heavy catches of this species were also made at Galveston. The writer was fishing from one of the Freeport boats on the 27th and personally saw 119 of these fish caught. On that day there were no signs of flying fish whatever, and in ten years he has not seen one in the territory from which the dolphin were taken, although *Dannichthys rondeletti* is occasionally common somewhat farther offshore. Furthermore it is extremely doubtful if dolphin the size of these (12 inches to 24 inches) consistently utilize flying fishes as food.

Occasionally large individuals are taken, one caught at Galveston in 1940 measuring forty-eight inches, but fish of this size are never so plentiful as the smaller ones which appear in great numbers each spring.

Family: Stromateidae

Genus: Peprilus Cuvier.

Species: *Peprilus paru* (Linnaeus): *Star, star-fish, harvest-fish.*

Ranges from Nova Scotia to South America.

Common along the entire Texas coast, these fish are taken at Galveston, Freeport, and Port Aransas, but never of sufficient size to make them economically valuable, as they are on the east coast of the United States. A number of small specimens were taken from beneath the umbrellas of *Stomolophus* at Port Aransas on the 26th of May, in 1940.

Genus: Poronotus Gill.

Species: *Poronotus triacanthus* (Peck): *Butterfish, dollar fish, butter perch.*

Ranges from Canada to Florida and along the northern Gulf coast. Taken at Galveston and Port Aransas, but common to the entire Texas coast.

Family: Carangidae

Genus: Trachurus Rafinesque.

Species: *Trachurus lathami* (Nicholas): *Rough scad.*

Recorded by Nichols (1920) as a stray from the Gulf stream. One specimen in the Rice collection taken from a shrimp trawl at Galveston. Common about Rockport, Texas, and Port Aransas, according to Mr. Gunter.

Genus: Paratractus Gill.

Species: *Paratractus crysos* (Mitchill): *Hardtail, runner, blue runner, jurel, yellow mackerel, crevalle, cojinera.*

Cape Cod to Brazil. Common at Port Arthur, Texas. Other specimens from Galveston and Freeport.

Genus: Xurel Jordan and Evermann.

Species: *Xurel lata* (Agassiz): *Xurel, jurel, horse-eye jack, big eye jack.*

Eastern coast of the United States and the tropical Atlantic. Reported by Weymouth (1911) from Cameron, Louisiana. Several specimens have been taken at Freeport and Galveston. Just how plentiful this and the preceding species may prove is not known.

Genus: Caranx Lacépède

Species: *Caranx hippos* (Linnaeus): *Crevalle, toro, horse crevalle, jack, jiguagua, yellow caranx, yellow jack, yellow mackerel, tourist tarpon* (Port Aransas).

East coast of the United States, north to Cape Cod and south to Brazil.

This is one of the most common of the carangids on the Texas coast, arriving in the spring with the first warm weather. In 1940 the first occurrence was on March the fourth, when a specimen was taken in a beach seine at Aransas Pass, but it is evidently present about Port Isabel most of the year, for during the freeze in January, 1940, large numbers of medium sized jack fish were washed up on the edge of the ship channel, numbed with the cold. A heavy run was reported from Port Aransas on May 1st, 1940, and at Port Isabel, two months earlier, on the 27th of March.

The species evidently spawns on this coast, for as early as June 2nd the author has seined numbers of the immature young from the surf on Galveston Island. These immature forms are quite noticeable, being ellipsoid in shape, and a brilliant greenish-brassy color, overlaid with dark vertical bars. By August first these youngsters have attained a length of six or seven inches and are miniature replicas of the parents, although a few still retain the dark, vertical barring so conspicuous in the younger fish.

Specimens of this size are quite vocal when caught, emitting a harsh, grating noise, similar to that of the familiar "piggie", *Orthopristis chrysopterus.*

Genus: Vomer (Cuvier and Valenciennes)

Species: *Vomer setipinnis* (Mitchill): *Jorobado, moonfish, lookdown, horsefish, sunfish.*

Common on the Atlantic coast, south to Brazil. A very common fish in the seines at Galveston Island, and frequent in the shrimp trawls at least as far south as Port Aransas. Specimens taken in July were less than one inch in overall length.

Genus: Argyreiosus

Species: *Argyreiosus vomer* (Linnaeus): *Moonfish, lookdown, jorobado, dory.*

Cape Cod to Brazil. Not especially common in Texas, although occasional individuals are taken. Represented in the Rice collection by several specimens from Rockport and Port Aransas.

Genus: Chloroscombrus Girard

Species: *Chloroscombrus chrysurus* (Linnaeus): *Bumper, yellowtail, casabe.*

Cape Cod to Brazil and throughout the West Indies. Very common on the Texas coast, although rarely attaining more than six or seven inches in length. One of the fishes most frequently taken in beach seines.

Genus: Trachinotus Lacépède

Species: *Trachinotus carolinus* (Linnaeus): *Pompano, pampano, butter fish.*

South Atlantic and Gulf coasts of the United States, common as far south as Brazil.

This species, arriving on our coasts early in the spring, is fairly plentiful. During June, July, and August large numbers of the young are present in the surf at almost any part of the coast, it being by far the most common species in any haul of a minnow seine at this time. They range in size from specimens less than one-half inch in overall length up to those of seven or eight.

Species: *Trachinotus palometa* (Regan): *Pompano, old wife, palometa.*

Tropical America from Virginia to the Caribbean. Reported in Texas by Fowler (1931) who noted two specimens in a beach seine at Corpus Christi.

Species: *Trachinotus falcatus* (Linnaeus): *Palometa, pompano, Spanish pompano.*

Represented in the Rice Institute collection by one specimen from Rockport.

Species: *Trachinotus goodei* (Jordan & Evermann): *Permit.*

Reported by Reed (1941) from the territory around Corpus Christi.

Genus: Oligoplites Gill

Species: *Oligoplites saurus* (Bloch and Schneider): *Leather-jacket, runner, zapatero, quiebra, sauteur.*

Both coasts of Central America, West Indies, and north to New York and Lower California.

Reported from Cameron, Louisiana, by Weymouth (1911), this species is represented in the Rice collection by specimens from Galveston and the lower coast. Evermann and Kendall (1892) obtained specimens at Dickinson Bayou, near Houston, from Galveston, from St. Joseph's Island and Corpus Christi.

Family: Seriolidae

Genus: Seriola Cuvier

Species: *Seriola lalandi* (Cuvier and Valenciennes): *Amberjack, amberfish, coronado.*

New Jersey to Brazil and throughout the West Indies. Occasionally taken at Port Arthur, Texas; often very plentiful at Heald Bank, off Galveston; also taken at the Claypile, south of Heald Bank, at the Flower Garden Reef, and on the deep banks off Freeport. Numbers of large ones have been caught off Port Aransas, and they are also reported from the reefs at Port Isabel.

Family: Pomatomidae

Genus: Pomatomus Lacépède
Species: *Pomatomus saltatrix* (Linnaeus): *Bluefish.*

Both sides of the Atlantic, as far south as the Cape of Good Hope. Also reported from the Mediterranean and from Australia and Madagascar.

Although once plentiful enough to support a small commercial fishery at Galveston, this species is not especially common at present. It is caught in the spring at Port Arthur, Galveston and Freeport, and Port Aransas, and may be found on our southern coast, although the writer has seen no specimens from below Corpus Christi.

They are often found mixed with schools of small dolphin.

Family: Rachycentridae

Genus: Rachycentron Kaup
Species: *Rachycentron canadus* (Linnaeus): *Ling, sergeant fish, lemon fish, cobia, crab eater, black bonito.*

World wide, being reported from China, the West Indies, the East Indies, and all warm seas.

A rather solitary fish in its habits on the Texas coast, it is found all the way from Orange to Port Isabel, although never in any great numbers. However, forty were taken in one day at Heald Bank off Galveston, and occasionally large numbers of the young are caught in Bolivar slips at the same place. One small specimen in the Rice collection is from Galveston, and an eighteen inch one from Rockport.

Doubtful species

Genus: Alectis Rafinesque
Species: *Alectis crinitus* (Mitchill).
Genus: Nomeus Cuvier
Species: *Nomeus gronovii* (Gmelin).

Both these species should be looked for, as they are probably present. *Nomeus* particularly should be found in some of the great numbers of Portuguese men-of-war that are encountered all along the Texas coast.

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THE EFFECTS OF IRRIGATION, FERTILIZATION, AND VARIETAL VARIATION ON THE YIELDS OF CASTOR OIL AND PULPED CELLULOSE PRODUCED BY CASTOR BEANS GROWN ON DARK SANDY LOAM SOIL

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The object of this study is to determine the yields of castor oil and stalk cellulose produced by different varieties of castor beans grown on a representative dark sandy loam soil of Southeast Texas with and without watering and fertilizing.

For our purpose we planted two fields of similar soil composition, an upland and a lowland, to castor beans of known varieties. The fields were prepared for planting as for cotton; that is, plowed and harrowed level in early spring. The planting was done the first of April. Each field was divided into eight plots, each plot being planted with beans of a known variety. The beans were planted by hand in rows six (6) feet apart, at an average distance of six (6) feet apart in the row.

One-half of each plot in the lowland field was fertilized with commercial balanced fertilizer containing nitrate, potash, and phosphate. The upland field was not fertilized. The two fields were cultivated similarly, being hoed and plowed until the bloom spikes began to appear. The lowland field was irrigated periodically throughout the dry summer and the early fall months. The upland field was not irrigated.

The leaves, stems, and smaller stalks were killed by a freeze in the middle of November. A week later, November 22, the beans were harvested. The spikes were cut off with sharp knives and the seed pods rubbed off by hand. The beans were removed from the pods by hand, with the aid of a pocket knife, and weighed. The bean meats were shelled and the castor oil was removed by ether extraction of weighed samples.

The stalks were allowed to stand in the fields until December 30, when they were cut down, trimmed up, and weighed. Representative samples were dried, pulped, and nitrated. The remaining stalks have been stacked to preserve them for cellulose preparations which we plan to carry on at this Laboratory during the coming summer.

The experimental results of this investigation are shown in Table 1, and a comparison of the yields of cellulose is shown graphically in Figure 1.

In a typical extraction experiment a sample of beans of the Big Black variety was shelled and the meats triturated with three successive 30 ml portions of dry ether. The extracts were combined in a weighed 250 ml Erlenmeyer flask and the ether distilled off over a water bath. The flask containing the residual castor oil was weighed and the weight of the oil determined by difference.

Weight of sample of beans	10.12 g
Weight of oil extracted	3.87 g
Weight of oil in 1 bu. beans (calc.)	17.60 lb.
Weight of oil in 1 acre yield from irrigated fertilized lowland (calc.)	704 lb. (88 gal.)

Samples of stalks of representative sizes were chipped and dried to constant weight in an oven at 110° C. immediately after harvesting. The average loss in weight on drying was found to be 47% of the weight at the time of harvesting (December 30). The weights of dry stalks entered in Table 1 are 53% of the yields of stalks per acre which were found from the weighings made in the fields when the stalks were cut.

Preliminary pulping experiments at this Laboratory indicate that, on the average, 10 lb. of dry castor stalk chips, on cooking in a liquor of sodium hydroxide and sodium sulfide, gives 4.2 lbs. of washed and dried cellulose pulp. The weights of pulped cellulose per acre of castor beans have been calculated, accordingly, by multiplying the dry stalk weight by the factor 0.42. On unfertilized irrigated lowland, the Crimson Spine beans, for instance, yielded 30 cwt. of dry stalks per acre; so the yield of pulped cellulose was 0.42 times 30, or 13 cwt. per acre.

Castor stalk cellulose pulped in the alkaline sodium sulfide cook, under conditions productive of highest nitration, gave a very explosive cellulose nitrate which possesses the characteristics of common gun cotton. The yield obtained is approximately 60% of the theoretical yield of gun cotton,

$\left(C_{12}H_{20}O_4\ (ONO_2)_6\right)_n$, from cellulose, $\left(C_{12}H_{20}O_{10}\right)_n$.

The annual per acre yields of gun cotton from castor stalks which are listed in Table 1 have been calculated by multiplying the respective weights of pulped cellulose by 0.6 times the chemical factor $\left(\frac{C_{12}H_{14}O_4\ (NO_3)_6}{C_{12}H_{20}O_{10}}\right)$.

For example, the Homesteader beans yielded 38 cwt. of pulped cellulose per acre on fertilized, irrigated lowland. Consequently the yield of gun cotton produced by the Homesteader beans in this case was 38 times $\left(\frac{594}{324}\right)$ times 0.6, which equals 42 cwt. of gun cotton per acre in one growing season.

A comparison of the yields obtained indicates that of the varieties studied the White Trinity beans are the most productive of both cellulose and castor oil in this section. The Homesteader beans are also highly productive both of stalks and of oil. The de Lafayette variety is the best producer of beans and oil but is lowest of all in cellulose production. The Vidor beans are also high in oil but low in cellulose production.

Irrigation increases the average yields of castor oil from 56 to 69 gallons per acre (23%) and of cellulose from 8 to 14 cwt. per acre (75%) on unfertilized sandy loam.

Fertilization with nitrate, potash, and phosphate blends increases the average yields of castor oil from 69 to 93 gallons per acre (35%) and of cellulose from 14 to 32 cwt. per acre (129%) when the loam soil is irrigated through the dry season.

The average yields are sufficient to suggest the possible practicability of the culture of dual purpose varieties of castor beans in the Gulf Coast region for the national defense.

The excellent lubricating properties of castor oil are well known. These are due to two remarkable physical characteristics of castor oil. One is its very small temperature coefficient of viscosity. Castor oil is highly resistant to heat and maintains its body at high temperatures. Yet it does not become objectionably stiff and viscous even in very cold weather. The other superior lubricating characteristic of castor oil is its ready adherence in very thin films to metallic bearings. Because of this property castor oil is vastly more efficient than mineral oil as a lubricant in close fitting, rapidly moving metal systems.

On these accounts castor oil is used extensively as a lubricant for aeroplane engines. It is materially improved for this purpose by treating it with an inhibitor. A blend of castor oil and mineral oil called "castrol" was put on the market by the Wakefield Company of London, England, prior to the outbreak of the present European War. This product was used extensively in the British Isles and British Dominions and was reported to give universally excellent results. In view of the increasing development of the aviation industry, average yields of 50 gallons of castor oil on unfertilized loam would seem to justify careful consideration of castor bean growing at the present time.

The yields of cellulose from castor beans, too, are impressive, particularly on fertile and well watered land. An upland loam average yield of 8 cwt. of cellulose per acre is nearly doubled by irrigating and is quadrupled by irrigating and fertilizing.

A comparison of these yields with the average cellulose yields from pine in this section is instructive. According to an estimate made by J. W. Cruikshank, I. G. Eldredge, and P. R. Wheeler of the United States Department of Agriculture[1], the average annual growth of pine wood from partly cut timber in southwest Texas is 35 cubic feet per acre. Of loblolly pine, having a density of 37 lb. per cu. ft., this is 13 cwt. of dry wood. Since loblolly pine wood is about 45% cellulose, the average annual production of cellulose from pine here is about 6 cwt. per acre.

Castor beans, yielding one and one-third times as much cellulose as pine, may be grown as a source of a part of the country's explosives, therefore, as well as a superior lubricant for the high speed machines. Large stalk varieties which are also highly productive of oil are most likely to be successful. Harvesting and marketing costs and losses from decomposition during assembling and storing of castor bean stalks, however, are much greater than for pine.

The practical possibility of growing castor beans as a source of pulp to supplement pine for paper manufacture, along with castor oil for lubricating purposes, is equally encouraging. Paper manufacture is a more permanent industrial use during peace times, which, if developed, may well make it profitable to continue castor bean culture in the Gulf Coast region after the present urgent demand for the manufacture of munitions is past. Heretofore, castor bean culture has waned during periods of peace, particularly because no industrial value was attached to the stalks.

[1] Forest Resources of Southeastern Texas, by J. W. Cruikshank, associate forest economist, and I. F. Eldredge, Chief, Field Division, Forest Survey, Southern Forest Experiment Station, Forest Service. U.S.D.A. Misc. Pubn. No. 326, 1939.

Table 1

Yield of Eight Varieties of Castor Beans, Showing Beans, Oil, Stalks, Pulped Cellulose, and Gun Cotton per Acre of Upland and Irrigated and Fertilized or Unfertilized Lowland Dark Sandy Loam Soil at the Sam Houston Experimental Farm from April to December, 1940.

IRRIGATED LOWLAND LOAM											
Fertilized					Unfertilized						
Bu. of Beans	Gal. of Oil	Cwt. of Dry Stalks	Cwt. of Pulped Cellulose	Cwt. of Gun Cotton	Bu. of Beans	Gal. of Oil	Cwt. of Dry Stalks	Cwt. of Pulped Cellulose	Cwt. of Gun Cotton	Variety of Beans	Plot No.
33	76	42	18	19	28	62	20	8	9	Yellow Spire	1
53	122	47	20	22	37	85	22	9	10	Vidor	2
59	138	30	13	14	47	106	17	7	8	de Lafayette	3
42	95	99	42	46	26	54	30	13	14	Crimson Spine	4
40	88	54	23	25	29	60	29	12	13	Big Black	5
35	79	91	38	42	23	55	33	14	15	Homesteader	6
49	108	133	56	61	41	97	61	26	28	White Trinity	7
21	40	103	43	47	17	31	54	23	25	la Marquise	8
42	93	75	32	35	31	69	33	14	15	Average	Av.
UNIRRIGATED UPLAND LOAM											
					Unfertilized						
					23	56	19	8	9	Average of Upland	

46 lb. =1 bu. castor beans.
8 lb. =1 gal. castor oil.
100 lb. =1 cwt.

Numbers 1-9, on irrigated and fertilized lowland; 10-18, on irrigated, unfertilized lowland; 1, 10, Yellow Spire; 2, 11, Vidor; 3, 12, de Lafayette; 4, 13, Crimson Spine; 5, 14, Big Black; 6, 15, Homesteader; 7, 16, White Trinity; 8, 17, la Marquise; 9, 18, average; 19, unirrigated, unfertilized upland average; 20, pine average for Southeast Texas.

THE PROCESSING OF WOOL AND MOHAIR: A NEW TEXAS INDUSTRY

By J. C. Godbey, Southwestern University

In 1939, the total production of mohair in the United States was 18,702,000 pounds. Of this amount, Texas produced 15,960,000 pounds. Which is 85.3 per cent of the total mohair clip. Texas also produced, in 1939, 21 per cent of the total wool clip of the United States, one Texas county alone producing 5,000,000 pounds, or 1.4 per cent, and ten counties from the heavy wool bearing area producing 10 per cent of the total yield.

The wool and mohair industry of Texas has made phenomenal growth in the last 30 years. This is well illustrated by the following tables:

WOOL		MOHAIR	
1914	8,000,000 pounds	1910	1,998,000 pounds
1920	22,813,000 pounds	1920	6,786,000 pounds
1930	48,262,000 pounds	1930	14,800,000 pounds
1934	60,864,500 pounds	1939	15,960,000 pounds
1938	79,305,000 pounds		
1940	82,000,000 pounds		

During this same 30 year period, however, wool production in the United States has remained surprisingly uniform, being about 375,000,000 pounds of shorn wool.

The value of the 1939 wool clip was $18,550,000.00 and that of mohair was $7,820,000.00. The total value of the wool and mohair produced in Texas during 1939 was greater than the total value of the vegetable crop of Texas including potatoes.

Disposition of Crop

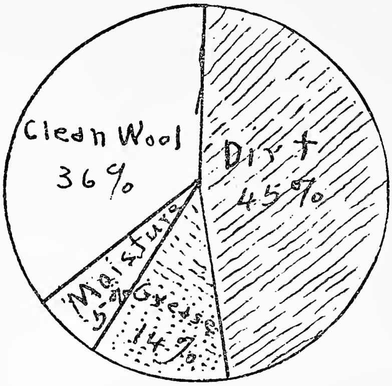
A common practice is followed in the handling of the clip in Texas. As quickly as possible after the shearing season is over, the wool is taken to warehouses. Some of these warehouses have as much as 3,000,000 pounds capacity. The usual practice is to tie each fleece into a separate bundle with paper twine and pack these into bales up to about 200 pounds. Eastern buyers then visit these warehouses and bid for the wool. Previous to 1939, the total crop was shipped out of the state, most of it going to the Boston area of the New England states.

Wool Grading

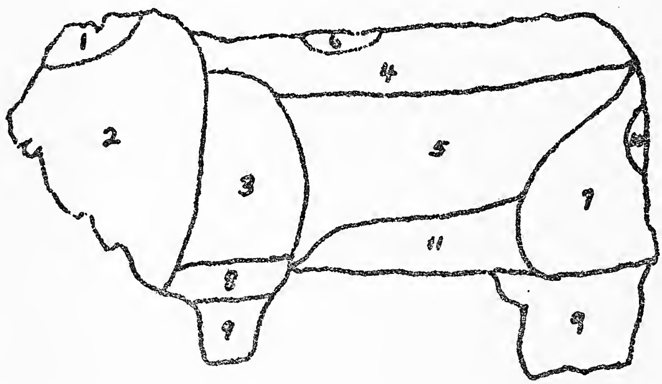
The buyer usually does his own grading. The grader examines the fleece without untying it, first giving attention to its fineness or diameter of fibre. The wool is then stapled to determine its length. It is also tested for strength and soundness. Tender wools are put into clothing wools regardless of length. Black fleeces, gray fleeces and fleeces that exhibit only a few black fibres through the main part are discriminated against and placed in separate containers. Shrinkage is also considered in grading. When the lot is large enough to justify it, that is when a large quantity is graded, the grader may desire to have two or three kinds of wool and of any one grade, the difference between them being largely one of shrinkage. Thus the No. 1 fine combing may have light shrinkage, the No. 2, medium shrinkage, and the No. 3, heavy shrinkage. Growers must understand that fleeces do not run uniform to one grade of wool. It may be a close question with many fleeces as to which grade predominates; in other words, they may be so close to the line that one grader might throw them one way and another grader the other. Unfortunately for Texas wool, the producers have known only 2 grades, burry wool and wool free from burrs, and the buying was done on a "hog-round" basis; that is the buyers would determine the average grades for an area and then bid on that basis. This tends to discourage the producer who is trying to improve flock strains for superior wool production.

Wool Shrinkage

Given below is a chart from the U. S. Department of Agriculture, showing how grease wool shrinks:



PARTS OF SHEEP REPRESENTING DIFFERENT SORTS:



1. TOP KNOT—Consisting of very light, short, moity and inferior wool.
2. NECK WOOL—Very light conditioned and long stapled wool, also containing coarse, matted lumps of inferior wool on the folds.
3. SHOULDER WOOL—The best wool grown by the sheep is obtained from the shoulder.
4. FLEECE WOOL—Consisting of good average fleece wool, usually free from vegetable matter.
5. BRISKET WOOL—Similar to shoulder wool (3) usually a little heavier.
6. BACK WOOL—This wool is inclined to be open and musky.
7. BRITCH WOOL—A coarser wool than other portions of the fleece and usually matted with burrs and seeds.
8. ARM PIECE—Very short wool surrounded by fribby edges—burrs and seeds collect heavily on this portion of the fleece.
9. HAIRY SHANKS—Hairy or kempy fibers containing very little wool; used for the manufacture of horse and cow blankets and carpets.
10. STAINED WOOL—This wool will not wash white and is very heavy in condition.

11. BELLY WOOL—A good bulky wool, heavy in condition, and usually burry and seedy.

Generally speaking, the best wool is that which comes from the shoulders and sides of the sheep, 3-5. Next in order is the wool from the back, 4. The rest of the fleece is classified in the order named: neck, britch, belly, chest, head, throat, and lower parts of the legs.

Shrinkage of Texas wool ranges from 33 per cent to 75 per cent with the average running between 60-64 per cent. The greatest shrinkage is in Panhandle wool with occasional clips, running between 70-80 per cent, while in the west central area some flocks have produced clips of 55-57 per cent shrinkage for good length 12 months wool. Shrinkage of greasy wools varies directly with the degree of fineness of grade. Fine wools shrink more than ½ blood wools, and ½ blood wools shrink more than ⅜ blood. Therefore, as the fibre increases in coarseness, the shrinkage declines.

Shrinkage is also related to length of fibre. This is especially true of fine and ½ blood wools, the long staples showing less shrinkage than the short staple wools. The significance of the shrinkage problem is manifold. It has to do with type of range production practices, flock management, sheep breeds and many other factors, but to the consumer its significance is summed up in a statement by Col. W. E. Talbot in "The Texas Banker's Record" of June, 1933:

"We are leading producers in wool, and every year pay freight on from 50 to 60 per cent dirt and grease to Boston, where the wool is washed, scoured, carded and combed, every bit of which could be done in our own state by our own people. The price of our wool is placed by Boston, based on an English market to whom we neither export nor import. The very finest worsted cloth is made from Texas wool. Yet we will get twelve and one-half million from our wool crop and see them in the East prepare it in the mills and increase this valuation to one hundred eighty-seven millions of dollars, every bit of which could have been retained in our own state, and would have brought more than our entire cotton crop."

It has been estimated that the freight paid by Texas producers on the dirt and grease in their wool amounts to approximately one million dollars. This does not take into consideration the freight paid on the finished product back to Texas.

Wool Sorting

Sorting consists of untying the fleece and separating it into its various qualities, a process entirely separate from grading.

Wool Scouring

The set-up of machinery in a wool scouring plant is called a scouring train. Five pieces of apparatus constitute the train. First, the wool is put through the dusting machine, which takes out much of the dirt. From here it goes to the First Bowl which is a vat about 12 feet long with a continuous belt to carry the wool through the bowl. The solution in the bowl contains 150 pounds of soda ash and 15 pounds of soap. It is kept at a temperature of 120° F. and it requires about 10 minutes for a sample of wool to pass through the bowl. When the wool has passed from one end to the other of the bowl, it goes through a squeeze roller into the second bowl. The second bowl is similar in appearance to the first, but contains a solution of 13 pounds of sintex, which is a special scouring compound. One of its functions is to neutralize the residual alkali from the first bowl. The temperature of this bowl is maintained at 115° F. and the duration 10 minutes. The wool passes through another squeeze roller into bowl 3, which contains only clear water. The time duration is ten minutes, but the temperature has been dropped to 110° F. Another squeeze roller takes the water out of the wool and it is now passed to the dryer which contains a revolving drum that circulates the wool. Drying time is 15 minutes and the temperature is kept at 190-210° F. The wool is now ready to be bagged for the spinners.

The average scouring train can handle 3,000,000 pounds of wool annually. One plant can have any number of scouring trains. There are only about 20 scouring plants in the U. S. However, most of the fine wool mills have their own scouring trains, since the wool must be handled according to their own formula. Hat, felt, and blanket mills use the short wools, tags, and clippings which can be processed in any scouring plant.

Yarn and Cloth

After the wool has been processed, it is ready to be converted into yarn and cloth. Given below is a table showing the distribution of spindles in the U. S.:

WOOLEN AND WORSTED SPINDLES IN THE UNITED STATES, JULY 1, 1936

STATE AND DIVISION	No. of Spindles	Percent of Total
Massachusetts	1,353,509	30.6
Rhode Island	765,895	17.3
Maine	328,961	7.5
Connecticut	191,379	4.3
New Hampshire	171,914	3.9
Vermont	75,764	1.7
TOTAL—New England States	2,887,422	65.3
Pennsylvania	520,801	11.8
New York	296,883	6.7
New Jersey	257,292	5.8
TOTAL—Middle Atlantic States	1,074,976	24.3
Ohio	66,418	1.5
Wisconsin	38,736	.9
Michigan	30,987	.7
Illinois	21,242	.5
Indiana	30,434	.7
Minnesota	12,947	.3
Iowa	8,920	.2
Missouri	2,900	.1
TOTAL—North Central States	212,584	4.9
Tennessee	42,364	1.0
Georgia	41,424	.9
North Carolina	25,272	.6
West Virginia	22,816	.5
Kentucky	21,680	.5
Virginia	21,542	.5
Maryland	10,386	.2
South Carolina	8,562	.2
Delaware	3,000	.1
Alabama	1,356	...
TEXAS	NONE	.0
TOTAL—Southern States	198,402	4.5
Oregon	23,694	.5
California	11,848	.3
Washington	3,066	.1
Utah	1,880	...
Wyoming	528	.1
TOTAL—Western States	41,016	1 0
TOTAL—United States	4,414,400	100.0

A New Industry

In 1938, the Legislature of Texas passed an amendment which made it possible to set up the organization of a corporation for the processing of wool in this state. A number of business men and producers promptly applied for a charter and organized the Cen-Tex Wool and Mohair Company. After an extensive survey, property was purchased near San Marcos, Texas, machinery was installed, and the first scouring train in the Southwest was put into operation in March, 1940. This plant will probably handle 1,000,000 pounds of wool its first year. But the company has recently branched still further, not only does it do scouring, storage, and commission business, it is now installing machinery for the manufacture of all wool blankets. Before the close of 1940 the hum of woolen spindles will be heard for the first time south of the Mason and Dixon Line and west of the Mississippi River. The Cen-Tex Wool and Mohair Company is owned and operated by Texans. It is only a small company but it may encourage others to show a like faith in the future of a great Texas industry.

OBSERVATIONS ON THE DRYING OF GRAPEFRUIT CANNERY RESIDUE FOR FEED

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Residues from orange and grapefruit juice canning are dried as cattle feed in California, Florida and Texas. In Texas little orange juice is canned, and drying operations are largely confined to grapefruit residue, which contains naringen, a bitter glucoside. Blackstrap molasses is commonly added to grapefruit residue to enhance the food value and sweetness of the feed.

Prior to drying in rotary kilns, residues are shredded in hashers similar to those used for grinding meat, in slicers, or in hammer mills with fixed or swinging hammers. Shreds one fourth of an inch square and three-fourths of an inch long are preferred by Texas drying plant operators.

As the residue is acid in character, most dryers adjust the pH to approximately 6.5 by adding six-tenths of one per cent of lime. Lime, reacting with the acid and pectin in the residue, renders it less corrosive to equipment, produces a crisp texture which permits separation of juice, and decreases the tendency to darken and stick to hot surfaces. Separation of liquor from the limed residue by draining or pressing, permits introduction into the kilns of material higher in insoluble solids, reduces fuel consumption, and results in increased kiln capacity in terms of dried feed. However, the yield of feed per ton of residue is reduced, and the resulting feed has a higher fiber content, and lower sugar and naringen content than feed produced from whole cannery residue.

For sweetened feed approximately 125 pounds of blackstrap molasses testing 55 per cent sugar, and 30 per cent solids, is added to each ton of pressed grapefruit residue before it enters the kilns. This lessens the average moisture content of the mixture, and increases the capacity of kilns in terms of dried product.

In a cooperative study of factors affecting quality and drying costs, records were made during three years of the composition of original, intermediate and final products, of yields, temperatures and humidity, and of fuel and power consumption.

In the commercial plant where these studies were made, four direct-heated, parallel-flow, rotary kiln driers, each 8 feet in diameter and 60 feet in length, were used. Fuel consisted of natural gas averaging 1025 B.T.U. per cubic foot.

Tests made when kilns were operated for short periods indicated a thermal efficiency of approximately 55 per cent.

The temperature of mixed gases discharging from kilns was measured and controlled by recording-controllers, which throttled the fuel supply when temperatures exceeded those at which the controllers were set to operate. These controllers were set for maximum temperatures ranging from 220° to 270° F. The flow of material through the kilns was controlled by adjusting the supply of residue and by regulating the draft induced by exhaust fans.

During the first two seasons covered in these studies all kilns were operated in parallel as single stage driers at exhaust temperatures of approximately 260° F., drying residue with or without added molasses to a moisture content of 9 per cent.

During the third season two kilns were operated in parallel as first stage driers at exhaust temperatures below 230° F., drying residue with or without added molasses to a moisture content of 32 per cent. The combined material from two primary driers was then passed through a third kiln operated as a second stage drier. Here the moisture content was reduced to approximately 9 per cent.

Difficulty in exactly controlling the moisture content, and the tendency of the material to reabsorb moisture during storage are reasons given by drying plant operators for drying to a moisture content less than the 12 per cent sufficient for preserving the feed.

Evaporative Capacity of Kilns:

Tests conducted during three seasons established the maximum evaporative capacity of these kilns under varying conditions.

1. *Operated single stage:* The quantity of feed dried in the kilns, when operated at 260° F., drying pressed residue of 77 per cent moisture content (or pressed residue with added molasses of 68 per cent moisture content) to less than 10 per cent, indicated a maximum evaporative capacity of approximately 8800 pounds of water per hour. Feed dried at this temperature had a dark color; and a considerable quantity of charred flue dust, suitable only for fertilizer, was produced. This flue dust often contained sparks and several days storage in the open was necessary to avoid fire hazard.

2. *Operated in two stages:* The quantity of feed dried in each kiln operated as first stage driers at 230° F., drying drained residue of 82 per cent moisture content (or drained residue with added blackstrap molasses of 78 per cent moisture content) to 32 per cent, indicated an evaporative capacity of approximately 8300 pounds of water per hour.

The quantity of feed processed in kilns operated as second stage driers, at an exhaust temperature of 105° F., reducing the moisture content from 32 per cent to less than 10 per cent, indicated the evaporation of 4000 pounds of moisture per hour. Limited by the quantity of material available from the two kilns operated as primary stages, this probably did not represent the full capacity of the kiln. If a larger quantity of partially dried residue of 32 per cent moisture content were available, evaporation in the kiln operated as a second stage drier could probably be increased without causing darkening or the loss of material as charred flue dust.

Pressing and Draining:

When limed citrus residue is drained or pressed the production of feed per kiln and per unit of fuel is increased. This may lead to the supposition that heaviest pressing results in lowest drying costs. Actually, heavy pressing may remove sufficient soluble carbohydrates to appreciably lower the nutritive value of the dried material, and may increase hauling, labor, power and waste disposal costs per unit of finished product sufficiently to offset savings in fuel and kiln capacity.

Tests conducted during three seasons show that liquor pressed or drained from the residue contained approximately 11 per cent of soluble solids, 1 per cent of insoluble solids, and ½ per cent of ash, and ranged from 40,000 to 80,000 parts per million in five day Biochemical Oxygen Demand. Disposal of this press liquor without creating a nuisance or causing stream pollution is a problem in South Texas, where drainage is limited and soils in low areas are heavy and not adapted to rapid absorption of such waste.

Draining or pressing the residue facilitates handling, increases kiln capacity, and reduces the cost of fuel per ton of feed produced, but the relative advantage of draining and of light and heavy pressing cannot be determined without considering the composition and quantity of residue to be dried, the quality and yield of dried feed, and power, labor and waste-disposal costs in the community where the plant is located.

Variations in Pressing Practice and Composition of Residue:

To determine the yields of pressed residue and liquor resulting from variations in the moisture content and handling method, an algebraic or graphic method described by Pearson (4) was employed. This may be summarized as follows:

When constituents of varying concentration are combined to form a mixture of intermediate composition, the quantity of each constituent is inversely proportionate to the difference in its percentage of composition from that of the intermediate mixture.

Conversely, when constituents of varying composition are separated from a mixture, the quantity of each will be inversely proportionate to the difference in its percentage of composition from that of the original mixture of intermediate composition.

This may be represented graphically in the form of a cross. To illustrate: the original limed residue may contain 83 per cent moisture, which may be reduced to 75 per cent by expelling liquor containing 90 per cent moisture. Solving graphically for the relative quantities of press cake and press liquor:

Moisture content of press cake ╲ ╱ Proportion of press cake

Moisture content of original residue

Moisture content of press liquor ╱ ╲ Proportion of press liquor.

or

75% ╲ ╱ 90 — 83 = 7 parts press cake

83%

90% ╱ ╲ 83 — 75 = 8 parts press liquor

For each 7 parts of press cake secured, 8 parts of press liquor will be expelled. If 2000 lbs. of limed residue were pressed, there would be obtained 7/15 of 2000 lbs. or 933.3 lbs. of press cake containing 25 per cent (233.3 lbs.) dry substance. There would also be obtained 8/15 of 2000 lbs., or 1066.7 lbs. of press liquor containing 10 per cent (106.7 lbs.) of dry substance. These calculations may be checked by addition, the sum of press cake and press liquor being 2000 lbs., and the sum of dry substance in cake and liquor being 340 lbs. (83 per cent of 2000 lbs.).

The 933.3 lbs. of press cake, containing 233.3 lbs. of dry substance, would yield 259.25 lbs. of feed of 10 per cent moisture. Each pound of feed produced would represent 7.7 lbs. of limed residue, of which 4.1 lbs. would have to be disposed of as press liquor and 2.6 lbs. evaporated. Without pressing or draining (or if the press liquor were concentrated and recombined with the residue for drying), the yield would be 377.8 lbs. of feed, each pound of which would represent only 5.3 lbs. of limed residue with no press liquor disposal expense.

The applicability of these calculations was demonstrated in a series of tests in which moisture determinations and measurements of yield were correlated.

Analyses, made during three seasons, showed the following ranges in the moisture content at varying stages of the process:

Limed residue, 81 to 84.5 per cent.
Drained residue, 79 to 82 per cent.
Pressed residue, 75 to 78 per cent.
Separated liquor, 87.2 to 89.5 per cent.

In other sections it is claimed that the moisture content of residue is reduced to 70 per cent by heavy pressing. It is possible to estimate the maximum and minimum yields of press cake, press liquor, and feed within these ranges in moisture content.

Case 1: A *minimum* yield of feed would be secured

Pressing limed residue containing 84.5 per cent moisture,
Separating liquor containing 87.2 per cent moisture, and
Recovering press cake containing 70.0 per cent moisture.

Application of Pearson's algebraic analysis reveals the ratio of press cake to press liquor would be 2.7 : 14.5, as 2000 lbs. of limed residue containing 310 lbs. of dry substance would yield 313.95 lbs. of press cake containing 94.19 lbs. of dry substance, and 1686.05 lbs. of press liquor containing 215.81 lbs. of dry substance. Drying the press cake in kilns to 10 per cent moisture would require evaporation of 209.30 lbs. of moisture and would yield only 104.65 lbs. of feed.

Each pound of feed produced would require 19.11 lbs. of cannery residue, whereas if pressing were avoided, or if the press liquor were concentrated and recombined with the residue before drying, each pound of feed would require only 5.87 lbs. of cannery residue.

In this instance if the press liquor is discarded the reduction in yield caused by heavy pressing is very large.

Case 2: A *maximum* yield of feed, using moderate pressing within the observed range in composition would be secured

Pressing limed residue containing 81 per cent moisture,
Separating liquor containing 89.5 per cent moisture, and
Recovering Press cake containing 77 per cent moisture.

Application of the Pearson's algebraic analysis reveals that the ratio of press cake to press liquor would be 8.5 pounds of press cake for each 4 pounds of press liquor, as

2000 lbs. of limed residue containing 380 lbs. of dry substance would yield
1360 lbs. of press cake containing 312.8 lbs. of dry substance, and
640 lbs. of press liquor containing 67.2 lbs. of dry substance.

Drying the press cake in kilns to 10 per cent moisture content would require evaporation of 1012.45 lbs. of moisture, and would yield 347.55 lbs. of feed. Each pound of feed produced would require 5.75 lbs. of cannery residue and the disposal of 1.84 lbs. of press liquor.

If the cannery residue were dried without pressing, or if the press liquor were concentrated and recombined with the press cake for drying, 422.2 lbs. of feed would be produced. Each pound of feed produced would require only 4.73 lbs. of residue.

In this instance the reduction in yield by this moderate pressing is relatively slight.

Case 3: An *average* yield of feed within the observed range in composition, reducing the moisture content of the limed residue 2 per cent by draining would be secured

Draining limed residue containing 83.0 per cent moisture,
Separating liquor containing 89.0 per cent moisture, and
Recovering drained residue containing 81.0 per cent moisture.

Application of Pearson's algebraic analysis reveals that the ratio of drained residue to drained liquor would be 6 pounds of residue for each 2 pounds of drained liquor, as

2000 lbs. of limed residue containing 340 lbs. of dry substance would yield
1500 lbs. of drained residue containing 285 lbs. of dry substance, and
500 lbs. of drained liquor containing 55 lbs. of dry substance.

Drying the drained residue in kilns to 10 per cent moisture content would require the evaporation of 1183.33 pounds of moisture and would yield 316.67 pounds of feed. Each pound of feed produced would require 6.31 pounds of limed residue, compared to ratios as high as 19.11 : 1 and as low as 5.75 : 1, and a probable average of 8 : 1 when pressing is used.

The above illustrations, based upon actual analyses and operating tests, reveal that heavy pressing greatly reduces the yield of feed in relation to the quantity of residue employed, unless the separated liquor is concentrated and recombined in the manufacture of feed.

Draining and moderate pressing reduce the yield relatively smaller amounts.

Any method involving pressing or draining raises the problem of disposing of the separated liquor, the quantity of which is large when appreciable quantities of residue are drained or pressed.

Utilization of Pressed and Drained Liquor:

Even with moderate pressing considerable quantities of liquor are separated from the limed residue. Ranging from 40,000 to 80,000 p.p.m. in B.O.C., this liquor cannot be discharged into city sewers without overtaxing the capacity of sewage disposal plants designed to handle domestic sewage (averaging 350 p.p.m. B.O.D.) in cities of less than 20,000 population.

Some economically practical method for disposing of this liquor is essential to the operation of a drying plant where pressing is employed.

Two methods have been tested experimentally by members of this Laboratory:

The first consisted of fermenting to recover alcohol and yeast, or to produce an effluent suitable for use in irrigation or disposal in furrows by evaporation and seepage, and the second of concentrating the liquor for use in the feed.

Fermentation of filtered press liquor for 72 hours with baker's yeast reduced the soluble solids from 10 per cent to 3.5 per cent, and the ash content from 0.6 per cent to 0.5 per cent, indicating that the clear liquor contained 6.5 per cent of combined fermentable carbohydrates and precipitable material, 0.5 per cent of inorganic solids, and 3 per cent of organic substance not removed by fermentation and precipitation.

Pulley and von Loesecke (7) reported the recovery of 0.3 per cent naringen from Florida grapefruit cannery residue, and found 0.5 per cent naringen in press liquor. As Pulley (6) found that the solubility of naringen in water at 20° C. is only 0.5 parts per 1000 and at 35° C. is 0.79 parts per 1000, much of the naringen could be removed by filtration of the press liquor. Pulley and von Loesecke reported the recovery of 20 per cent rhamnose and 42 per cent naringenin by hydrolysis of naringen, indicating the possibility of commercial application if uses for rhamnose and naringenin were developed.

Fermentation of Press Liquor:

In tests make in Texas, samples of press liquor were inoculated with compressed baker's yeast and fermented with and without the addition of acid juice. Fermentation was virtually complete within 72 hours. When actively fermenting starter was added, the fermentation was substantially completed within 48 hours. The soluble solids of the press liquor were reduced 60 percent and the yeast sludge settled compactly, indicating the practicability of recovering the settlings for drying in the feed.

The quantity of alcohol produced was too small to justify commercial recovery. Facilities were not available for undertaking experiments with lactic or butyric acid fermentations.

In other tests, conducted during two seasons, the press liquor from a drying plant was combined with the sewage from four citrus juice canneries. After screening, the combined waste had an average pH of 4.8, tested 1 to 2 per cent soluble solids, and ranged in B.O.D. from 1000 to 5000 p.p.m. The wastes were inoculated with baker's yeast at the plants where they were discharged into a storm sewer. After flowing one and one-half miles through a concrete storm sewer the combined inoculated sewages were allowed to flow through three open pits, each 10 feet deep, 15 feet wide, and 150 feet long, connected by shallow ditches. Baffle- and scum-boards were arranged to impede the free flow of liquid through the pits. The pits were connected in series at progressively lower levels to permit gravity flow; and the combined capacity permitted an average retention of 48 hours at maximum flow.

Facilities were not available for cleaning or draining the pits, which filled with sediment after 60 days of operation so that abandonment was necessary. It was observed that so long as flow was maintained continuously a light colored sludge was formed, and a clear effluent with 25 per cent reduction in B.O.D. was discharged. The effluent possessed a faint unobjectionable odor resembling that of soured wine. The pH of the effluent ordinarily ranged from 3.5 to 4.5. The effluent was found suitable for mixing with water for orchard irrigation, and was found to be free from objectionable odors and from gummy substances which interfered with rapid absorption in the soil.

Tests of the possibility of further reducing the B.O.D. of the effluent by means of trickle filtration or activated sludge treatment were not made.

When the flow of sewage was interrupted for more than one day, septic action in the yeast sludge accumulated in the pits caused gas formation which brought the sediment to the surface, where it darkened and developed an objectionable odor.

Concentration of Press Liquors:

The press liquor may be clarified by filtration or centrifugal sedimentation. In a laboratory test three and a half gallons of filtered press liquor were concentrated under vacuum from 10 per cent soluble solids to 59 per cent. About 75 grams of precipitate were separated from the syrup by filtration. Microscopic examination revealed the presence of considerable quantities of naringen crystals in the precipitate. After extracting the precipitate three times with alcohol, then three times with hot water, an undissolved residue of 35 grams of material testing 40 per cent ash remained. Naringen was recovered from the alcohol soluble fraction, but no quantitative estimate was made.

The filtered syrup had a slightly bitter taste, and although it contained only 59 per cent solids, and 4 per cent of ash, it resembled black strap molasses, in odor and flavor and in sugar content on a moisture free basis. Treatment with activated decolorizing carbons had little effect on the color or flavor. A portion was concentrated to 80 per cent soluble solids with little additional precipitation of insoluble solids.

Whether the press liquor could be profitably concentrated and recombined with the residue instead of adding blackstrap molasses would depend upon the cost of concentrating to one-eighth of the original volume, preceded and followed by filtration (or other clarification) to substantially reduce the quantity of bitter glucoside in the feed. At the plant where observations were made, as much as 8000 gallons of press liquor were produced per hour during operation of four kilns. Small quantities of naringen and calcium citrate might be recovered, but returns from these by-products could not be depended upon to help defray the cost of concentration.

Triple-effect concentrating equipment of the capacity needed to handle the press liquor of commercial drying plants is available from southern cane sugar plants, where it has been replaced by equipment of larger capacity.

It has not been possible to determine whether scaling would occur in evaporator tubes. However, scaling is not a problem in concentrating the limed and clarified juice of sugar cane.

Approximately one boiler horsepower capacity would be required for each nine gallons of press liquor to be concentrated per hour. A fuel saving as high as 70 per cent is possible in evaporating water in triple-effect evaporators in comparison to evaporating at atmospheric pressure. With proper installation radiation losses would probably be no larger in the triple-effect concentrators than in direct heated kilns. The advantage of a pressing and condensing operation might be estimated by setting the saving in fuel and waste-disposal cost against increases in the cost of condensing water, labor and power, and in overhead representing larger investment in presses, boilers, clarifiers and evaporators. Feed made by this process would contain most of the sugar present in the original material, whereas a large percentage of the bitter substance could be separated by clarification of the concentrated liquor.

Subterranean Disposal:

Another method which has been tried for disposing of press liquor was to screen it and pipe it under pressure into porous gravel strata 240 to 280 feet underground. Attempts by commercial operators to dispose of press liquor in this manner without first removing colloidal material resulted in failure. In many sections contamination of water supplies would render this procedure objectionable.

Summary and Conclusions:

Operating tests, analyses and calculations made in this study indicate that the capacity of kilns in terms of dried feed, may be increased as much as 30 per cent by pressing. However, in an extreme case, such as that cited in case number 1, more than two thirds of the total solids in the original residue might be lost in the press liquor if heavy pressing were used, and the press liquor were not recovered.

It is apparent that little is gained by pressing, unless (1) the quantity of residue to be disposed of exceeds the drying capacity of kilns, (2) the press liquor can be disposed of without expense, or (3) the press liquor is concentrated and recombined with the feed. If expelled liquor is concentrated and dried with the residue, the yield of feed is approximately the same as if pressing had not been used, and the reduction in bitterness and the mechanical and thermal advantage of triple effect evaporation may offset increased investment and labor costs.

Concentrating the press liquor for recombining with the feed would necessitate the installation of clarification equipment and multiple effect evaporators. Fermentation for the recovery of yeast solids would necessitate a specially designed plant, and the recovery of alcohol would not be practical. However, the effluent would be suitable for disposal by use in orchard irrigation.

The authors are indebted to the management of the Rio Grande Citrus Growers Exchange, to Consulting Engineer E. W. Kerr, of Baton Rouge, Louisiana, and to technical representatives of the gas and power companies for cooperation in securing the data upon which this report is based.

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A PRELIMINARY FISHERIES SURVEY OF THE SAN JACINTO RIVER WATERSHED

By Leonard D. Lamb, Texas Game, Fish & Oyster Commission

In recent years the decline in numbers of fish taken per fisherman day has caused the public to arrive at the conclusion that there is a marked scarcity of fish in our public streams. This general opinion has indicated the need for a survey of the streams of Texas to determine the true conditions. With this in mind a preliminary fisheries survey of the San Jacinto River Watershed was conducted during the summer of 1940, by the Texas Game, Fish and Oyster Commission. The streams surveyed compose a drainage system that lends itself readily to this type of work as it covers a rather small area.

The results of this investigation have a very practical application since the restocking program of the Game, Fish and Oyster Commission requires the expenditure of more than $40,000 per year. A program of this magnitude involves a great deal of responsibility if the anglers of the state are to derive the proper benefit. The stocking of these streams cannot be properly done without a knowledge of what fish the various streams can support and in what numbers they should be stocked. The present investigation has been conducted largely with the purpose of determining what species of fish, both game and non-game, were present in each stream. The food organisms other than fish were noted and the relative productivity of the stream estimated.

If the stocking program is to be conducted intelligently there must be information at hand with regard to the abundance and permanence of water both at the present and in the future. This information together with the suitability of the particular waters to the species of fish to be stocked composes one of the most efficient guides that the fish culturist has available.

METHODS AND EQUIPMENT

This fisheries survey has been conducted by the Texas Game, Fish and Oyster Commission with the assistance of the Department of Fish and Game of Texas A. & M. College, and was carried on during the months of June, July and October, with collections made at intervals as time and weather permitted.

Seining stations were located on the various streams of the watershed giving as complete coverage as time would allow. Several stations were located on each of the major tributaries with the minor streams receiving less attention. The collections were made with common sense seines and with bag seines having a ¼-inch mesh. The collections were preserved and estimates of population were made from the quantity of specimens taken together with the length, width and number of seine hauls. The food organisms, other than fish taken in the seines were preserved, identified, and counted to give estimates as to the productivity of the stream.

Stream flow data obtained from hydrographic and flood control work done by the U. S. Army Engineers, and the U. S. Soil Conservation Service were utilized in the estimates of present and future water conditions.

DESCRIPTION OF WATERSHED

The San Jacinto River empties into Galveston Bay at Lynchburg, Texas, and is composed of two streams which unite near Huffman to form the main channel. These two streams are the East fork and the West fork of the San Jacinto, which together with their tributaries form the drainage system known as the San Jacinto River Watershed which includes 3,018 square miles in Harris, Montgomery, Walker, Grimes, San Jacinto, Liberty and Waller counties.

This watershed lies entirely in the Coastal Plains Region and is included in three Geological belts. Liberty County lies entirely within the Quaternary belt while Harris, Montgomery, Waller and San Jacinto counties extend into both Quaternary and Pliocene-Miocene belts. Walker and Grimes counties lie in both Pliocene-Miocene and Eocene geological belts.

The most extensive soil types are the Lufkin-Susquehanna and the Segno-Caddo groups, of the East Texas Timber country region, which includes the greater part of the watershed. Walker County and parts of Montgomery, Grimes, San Jacinto and Waller counties are found in the Lufkin-Susquehanna group with the remainder of San Jacinto and Liberty together with the eastern part of Montgomery counties in the Segno-Caddo group. The southern part of Montgomery County lies in the Hockley-Katy group of the coast prairie region with the area along the lower part of the San Jacinto River composed of the Lake Charles-Edna group of the same region. The soil type along the streams belongs to the Alluvium region with Lake Creek and the upper part of West Fork of San Jacinto in the Trinity group and the other streams in the Ochlockonee group.

The San Jacinto River Watershed lies entirely within the humid belt and has an annual average rainfall of 45-50 inches. The region also has a climate that is considered sub-tropical in spite of the fact that killing frosts do occur, and on some occasions snowfall measuring 5 to 10 inches has been experienced.

The eastern half of the watershed is rather well forested with pine and some hardwoods. The greater part of this land is included in the Sam Houston National Forest and there are only scattered patches of cultivated land in the major part of this area. The western half of the watershed presents an entirely different aspect. The land is largely given to agriculture with scattered tracts of rather scrubby hardwoods with the uncultivated land badly overgrazed.

ANNOTATED LIST OF SPECIES

The following is a list of the species of fish taken from the streams of the San Jacinto River Watershed. The scientific and common names together with the arrangement of species conforms to those used by Hubbs and Bonham in an unpublished check list of Texas Fishes. The distribution data is limited to the number of collections in which the species was present together with the number of specimens and the streams from which they were taken.

Family LEPISOSTEIDAE — The Gars

Lepisosteus productus (Cope): Spotted Gar.
2 Colls. 2 Specimens — Found only in West Fork and Lake Creek.

Family CLUPEIDAE — Herrings

Dorosoma cepedianum (LeSueur): Gizzard shad.
4 Colls. 6 Specimens — Taken from East Fork, West Fork and Cedar Creek.

Family CATOSTOMIDAE — Suckers

Erimyzon sucetta kennerlii (Girard): Western lake chub sucker.
2 Colls. 3 Specimens — Taken from Spring and Cedar creeks.
Minytrema melanops (Rafinesque): Spotted sucker.
5 Colls. 5 Specimens — Taken from East Fork, Caney Creek and Winters Bayou.
Moxostoma congestum congestum (Baird & Girard): Texas gray redhorse.
2 Colls. 2 Specimens — Taken from Caney and Peach creeks.

Family CYPRINIDAE — Minnows

Opsopeodus emiliae (Hay): Pugnose minnow.
3 Colls. 3 Specimens — Mill Creek, Lake Creek and East Fork.
Notemigonus crysoleucas seco (Girard): Texas golden shiner.
5 Colls. 300 Specimens — East Fork, Winters Bayou, West Fork, Spring Creek, Willow Creek, Deckers Branch, Lake Creek, Cedar Creek, Robinson Creek, and Unnamed Tributary to Lake Creek.
Notropis fumeus fumeus (Evermann): Southern ribbon shiner.
5 Colls. 10 Specimens — Spring and Unnamed Tributary to Lake, San Jacinto, East Fork and Caney Creek.
Notropis umbratilis umbratilis (Girard): Southern redfin shiner.
6 Colls. 38 Specimens — Spring Creek, East Fork, Caney Creek and Winters Bayou.
Notropis venustus venustus (Girard): Texas blacktail shiner.
18 Colls. 1348 Specimens — West Fork, Spring Creek, Mill Creek, San Jacinto River, East Fork, Caney Creek, Peach Creek, and Winters Bayou.
Notropis lutrensis lutrensis (Baird & Girard): Plains red shiner.
7 Colls. 94 Specimens — San Jacinto River, Lake Creek, Winters Bayou, and East Fork.
Notropis amnis (Hubbs & Greene): Pallid shiner.
5 Colls. 76 Specimens — West Fork, Spring Creek, East Fork, San Jacinto River and Winters Bayou.
Notropis atrocaudalis (Evermann): Blackspot shiner.
3 Colls. 3 Specimens — West Fork, unnamed tributary to Lake Creek and Caney Creek.
Notropis volucellus nocomis: Texas mimic shiner.
7 Colls, 29 Specimens — West Fork, San Jacinto River, Caney Creek, East Fork, Peach Creek and Winters Bayou.
Hybognathus nuchalis (Agassiz): Silver minnow.
1 Coll. 1 Specimen — Spring Creek.
Cerathichthys vigilax (Gaird & Girard): Parrot minnow.
9 Colls. 71 Specimens — West Fork, Mill Creek, Spring Creek, San Jacinto River, East Fork, Caney Creek, Winters Bayou.

Family AMEIURIDAE — Catfishes

Ameiurus melas catulus (Girard): Southern black bullhead.
4 Colls. 64 Specimens — West Fork, Deckers Branch, Robinson Creek and Winters Bayou.
Ameiurus natalis (LeSueur): Yellow bullhead.
2 Colls. 3 Specimens — West Fork and East Fork of San Jacinto River.
Schilbeodes nocturnus (Jordan & Gilbert): Freckled madtom.
4 Colls. 8 Specimens — San Jacinto River, East Fork, Caney Creek and Winters Bayou.

Family ESCOIDAE — Pikes

Esox vermiculatus (LeSueur): Little pickerel.
7 Colls. 9 Specimens — West Fork, Robinson Creek, East Fork, Peach Creek and Winters Bayou.

Family CYPRINODOTIDAE — Killfishes

Fundulus notatus olivaceus (Putnam): Southern blackband topminnow.
26 Colls. 639 Specimens — East Fork, Caney Creek, Peach Creek, Winters Bayou, West Fork, Spring Creek, Mill Creek, Lake Creek, Cedar Creek, unnamed tributaries to Lake Creek and Robinson Creek.
Gambusia affinis affinis (Baird & Girard): Western mosquitofish.
26 Colls. 501 Specimens — San Jacinto River, East Fork, Caney Creek, Peach Creek, Winters Bayou, West Fork, Mill Creek, Willow Creek, Spring Creek, Deckers Branch, Lake Creek, Cedar Creek and unnamed tributary to Lake Creek.

Family APHREDODERIDAE — Pirate Perches

Aphredoderus sayanus gibbosus (LeSueur): Western pirate perch.
4 Colls. 11 Specimens — Deckers Branch, Lake Creek, and Winters Bayou.

Family PERCIDAE — Perch-like Fishes

Hadropterus scierus (Swain): Dusky darter.
5 Colls. 21 Specimens — West Fork, Deckers Branch, East Fork and Caney Creek.
Ammocrypta viviax (Hay): Arkansas sand darter.
8 Colls. 40 Specimens — West Fork, Spring Creek, San Jacinto, East Fork and Caney Creek.
Boleosoma chlorosomum (Hay): Bluntnose darter.
2 Colls. 2 Specimens — West Fork and Winters Bayou.
Hololepis gracilis (Girard): Western swamp darter.
3 Colls. 4 Specimens — West Fork, Lake Creek and Winters Bayou.

Family CENTRARCHIDAE — Sunfishes

Micropterus punctulatus (Rafinesque): Spotted bass.
4 Colls. 8 Specimens — West Fork, East Fork, Peach Creek and Winters Bayou.
Huro salmoides (Lacépède): Largemouth bass.
7 Colls. 15 Specimens — West Fork, Deckers Branch, Cedar Creek and Winters Bayou.
Chaenobryttus gulosus (Cuvier): Warmouth bass.
4 Colls. 11 Specimens — West Fork, Deckers Branch, Lake Creek and Winters Bayou.
Lepomis cyanellus (Rafinesque): Green sunfish.
11 Colls. 77 Specimens — Caney Creek, Winters Bayou, West Fork, Robinson Creek, Spring Creek, Willow Creek, Deckers Branch, Lake Creek, unnamed tributary to Lake Creek and Robinson Creek.
Lepomis symmetricus (Forbes): Small sunfish.
5 Colls. 16 Specimens — Willow Creek.
Lepomis microlophus (Gunther): Redear sunfish.
1 Coll. 5 Specimens — West Fork of San Jacinto River.
Lepomis megalotis (Rafinesque): Longear sunfish.
17 Colls. 97 Specimens — San Jacinto River, East Fork, Caney Creek, West Fork, Spring Creek, unnamed tributaries to Lake Creek, Willow Creek, Mill Creek, Deckers Branch and Winters Bayou.
Lepomis macrochirus (Rafinesque): Bluegill sunfish.
7 Colls. 18 Specimens — West Fork, Spring Creek, Deckers Branch and Lake Creek.
Pomoxis annularis (Rafinesque): White crappie.
2 Colls. 4 Specimens — West Fork and Lake Creek.

Family ATHERINIDAE — Silversides

Menidia menidia (Linnaeus): Silversides.
1 Coll. 3 Specimens — San Jacinto River.

Labidesthes sicculus (Cope): Brook silversides.
5 Colls. 64 Specimens — West Fork, Spring Creek, San Jacinto River and Caney Creek.

DISCUSSION

This investigation has shown the San Jacinto Watershed to be populated with a wide assortment of fish. The thirty-nine species recovered represent twenty-seven genera and eleven of the twenty-eight families known to inhabit the fresh waters of Texas.[1] The game and pan fishes are represented by all the species known to exist in southern Texas with the exception of the Black Crappie and the Channel Catfish. The species were rather evenly distributed and with a few exceptions appeared to be almost universal.

The East Fork and its tributaries yielded the only collection of Spotted suckers, Texas gray redhorse, Freckled madtom and Silversides while the West Fork and its tributaries provided the only specimens of White crappie, Silver minnow, Spotted gar, Redear sunfish, Small sunfish, Bluegill sunfish, and Western lake chub sucker encountered in the survey.

The presence of Crappie in the West Fork and its tributaries offers a decided contrast to the eastern side of the watershed where none were recovered. This can be accounted for, however, when the different streams are taken into consideration. The eastern side of the watershed is composed largely of shallow, clear, sand bottom streams while the western side is made up of deeper, murky, mud bottomed streams for which Crappie exhibit a preference.

The Bream population is rather well distributed while the Green sunfish and the Longear sunfish are most predominant. These fish are native to these streams but are also distributed from the hatcheries at Huntsville and Jasper. The various species of Bream show marked ability to adapt themselves to the different conditions they may encounter and therefore are found to be present in practically all types of water that other fresh water fish inhabit.

The supply of forage species was found to greatly exceed that of game and pan fish but was not adequate to support a greatly increased population of predacious species. The following table gives the ratios of the various game species to the other groups. The panfish includes only the Bream while the minnow group includes all forage species that do not normally grow too large to serve as food for an adult bass. The rough fish includes: Suckers, Gar, Shad and Pickerel.

RATIO OF GAME FISH TO OTHER SPECIES

	EAST FORK			WEST FORK		
	Bass	Crappie	Warmouth	Bass	Crappie	Warmouth
Pan Fish.......	1:3.5	0:28	1:9133	1:9.4	1:35.25	1:17.62
Cat & Bullhead.	1:237	0:19	1:6.33	1:3.06	1:14	1:7
Minnows.......	1:992	0:1594	1:09.8	1:412	......	1:206
Rough Fish.....	1:1.63	0:13	1:4.33	1:07	1:3.5	1:1.75

The inverterbrate food organisms were found to be adequate to support a slightly larger population of fish than is present if the number recovered may

[1] Hubbs, Carl L., and Bonham, K., 1940 unpublished data.

be taken as an index. The most prevalent forms were freshwater shrimp and crayfish together with the larvae and nymph stages of larger insects. These forms were rather abundant in the streams that compose the western side of the watershed but were present in fairly large numbers in Winters Bayou and Caney Creek. The smaller insect larvae such as the midges, mosquitoes and others of that size were very numerous in the muddy bottoms of the West Fork, Lake and other similar streams of the western side of the watershed but were not so prevalent in the clear sand bottom streams of the East Fork and tributaries.

The abundance and permanence of water is not a problem in this region since the annual rainfall amounts to 45-50 inches. The streams are for the most part permanently flowing and in all cases retain sufficient water in pools to care for the fish. The western side of the watershed is confronted with a problem of silting much more than is the eastern side because of the differences in soil and cover. The streams of the eastern side of the watershed have all been polluted by the Conroe oil field with the exception of Winters Bayou but at the present time the pollution has been so reduced that it is no longer detrimental.

That the waters of this section are suitable for fish is adequately proven by the fact that there are fish living in them at present and they are apparently in good health. It is evident that Crappie do not find the waters of the East Fork and its tributaries favorable since they are not present there despite repeated stockings from the State Fish Hatcheries. The evident scarcity of bass is not expected in view of the fact that these waters have been rather heavily stocked with fingerlings of Largemouth and Spotted bass. These stockings have occurred regularly since 1932.

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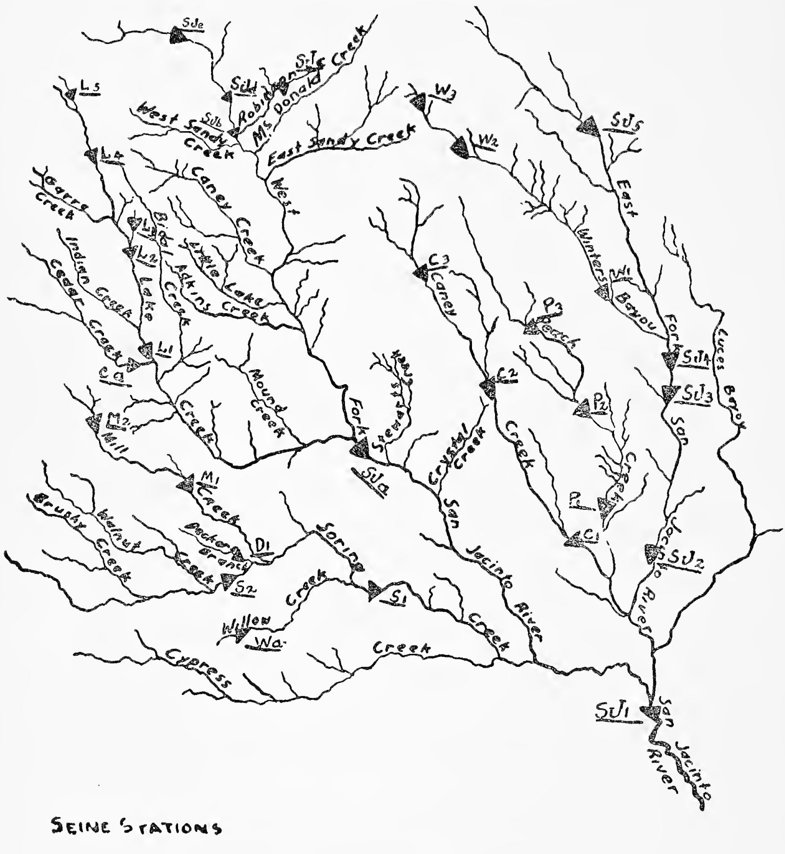

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SEARCHING THE HEAVENS
(The Mystery of Beta Lyrae)

By Otto Struve, Fort Davis

No other star in the heavens has been observed as much and has been discussed by astronomers as thoroughly as has β Lyrae. It is an interesting coincidence that at the dedication of the Yerkes Observatory in October, 1897, one of the principal scientific addresses was devoted to the problem of this mysterious star.

It is a bright star easily visible to the naked eye. The Arabs called it Sheliak, and the ancient Chinese knew it as Tsan Tae. It is normally a star of the third magnitude, a few degrees south of the brilliant star, Vega. In 1784 a young deaf-mute astronomer, John Goodricke, of York England, noticed that the light of β Lyrae was not always uniformly bright, but that on some nights it appeared relatively faint. Later astronomers concluded that the variations in light were perfectly regular and repeated themselves every thirteen days.

Since the discovery of Goodricke, more than two hundred scientific publications have been devoted to the study of this star, hundreds of thousands of observations have been secured, and probably about one million dollars have been spent in trying to explain what really happens in the thirteen-day period β Lyrae.

Many strange theories have been proposed. One astronomer thought that the substance of the star may be burning and that every thirteen days the supply gives out, so that the light becomes dimmer. A new increase in the supply of fuel makes the furnace go again full blast and the star is once more normal in light.

Another famous astronomer suggested that the star may be full of spots, and that by turning around its axis it sometimes presents to us the spotted side, and sometimes the clear side. Still another thought that β Lyrae may be flat, like a millstone, and that by turning it sometimes is seen from the broad side and at other times from the narrow side. All of these early theories now sound antiquated, but at the time when they were proposed they were entirely logical, and fully justified by the status of knowledge. Some of them have come back to us in a new and modern dress, and we shall see that both the spot theory and the theory of the flattened millstone are required to explain — in modern form — some of the minor effects observed in β Lyrae.

The principal theory of β Lyrae, now accepted by all astronomers, proposes that the star is not single, but consists of two suns revolving around another in a period of thirteen days. This much may be regarded as certain. But when we try to fit into this picture the numerous facts collected by the observers, we are invariably led into conflict with this basic theory. The conflict has been recognized for many years, and numerous astronomers have tried to solve the riddle. The point is that the variations in the brightness of the star unquestionably prove the existence of the two binary suns. The spectrum supports this conclusion and we can see very clearly on the spectrographic photographs that there are two distinct sets of absorption lines, very much as though two separate stars had been photographed through the instrument one after another without changing the film. At first sight everyhing seems to be in accordance with the binary hypothesis, and there is nothing unusual about having a double star of the type described. There are hundreds just like it.

But when we look into the matter more carefully we find to our consternation that the binary hypothesis definitely leads to the conclusion that one star must be hot while the other must be cool. The spectral lines which we observe with the spectroscope equally definitely prove that the two sets of spectral lines come from two equally hot bodies. The discrepancy may seem small and unimportant. The casual listener may think that there are so many unexplained phenomena in the Universe, that it need not bother us that there is a discrepancy in the temperature of one component sun, as determined from the light curve and as determined by the spectroscope. But a scientist knows that often the most minute and apparently insignificant discordance will lead to important results. In the case of β Lyrae the discrepancy mentioned has completely altered the picture of the star, and has, in addition, given us the realization that our material universe contains objects of hitherto unknown and even unsuspected structure and physical properties.

The process which we have followed at the Yerkes Observatory and at the McDonald Observatory during the past few months have been to develop each theory to its logical conclusion. This work has been done principally by Professor Gerard P. Kuiper, who has investigated one aspect of the problem, and by the present speaker who has concentrated his attention more particularly upon the other, the spectroscopic aspect. Several other members of the observatory staffs have taken part in the work. As a result of this collaboration all major effects in β Lyrae are now explained.

The difficulty with our previous interpretation was that we had erroneously, as it turns out, thought that both sets of spectral lines come from stars. One actually does come from a star — a hot supergiant, of tremendous luminosity, great mass, and very small density. The other superposed set of lines comes from a nebulous ring of gas, spread out in a spiral form around the hot star. The spiral revolves around the star, and matter is constantly streaming along the arms of the spiral from the supergiant star into infinite space. The whole object is like a pinwheel firecracker, on a stupendous scale.

The star is actually a binary, just as the older theory had predicted. Only the cool and relatively small star, which turns around the hot supergiant, is so much fainter in light that we cannot even photograph it — because the exposure time required to record it would so completely over-expose the image of the hot supergiant that the photographic emulsion would be burned out. Of course, the distance of β Lyrae is so great that we cannot actually see the pin-wheel structure of the expanding gases, or the motion of the faint companion around the primary star. Even the greatest telescope now in existence is much too small to bring this marvel to our eyes. We must be content with information secured by theory and indirect observation.

Imagine, then, a giant sun so hot that its color is essentially blue, so large that a good portion of the entire solar system could be hidden within its confines, and so brilliant that our sun would completely disappear in its glare. A short distance away — probably less than one-half of the diameter of the large star, is another sun, yellow in color, and relatively cool though hotter and considerably larger than our sun. This yellow sun revolves around the blue supergiant once in thirteen days. Its pull of attraction upon the supergiant is tremendous. Tides tend to elongate the latter until its shape is like that of an egg and until some of its outer gases coalesce with the gases of the yellow sun. As soon as contact between the two stars is established, matter will start rushing from the hot supergiant toward the yellow star, and we measure the speed of this eruption as one hundred or more miles per second. Some of this erupted matter sweeps along the surface of the yellow star, where it is cooled and reduced in speed, until it finally returns to the parent star with a speed of fifty miles per second. But only a small part — probably less than half — of the erupted matter even returns to the blue supergiant. Under the force of combined attraction of the two stars and, in consequence of some of the basic laws of motion, a part of the erupted gas is thrown past the yellow star and is forced to spiral out at first in a narrow band, later in an ever-widening spiral arm, until it is gradually lost in the space between the stars. This spiral is hot — almost as hot as the blue supergiant — and the gases shine in all the colors of the common electric signs seen in our streets at night. There is a luminous hydrogen with its red tinge, helium with yellow and green, neon with its red. The matter spirals out with a velocity of close to one hundred miles per second.

The size of this gigantic pinwheel may be one hundred million miles or even more. Its distance is so great that light, traveling at a rate of 186,000 miles per second, requires 1500 years to cover it. The mass of the principal star in the system is about one hundred times larger than that of the sun, and its output of light is about ten thousand times greater than that of the sun.

There are no other stars known to astronomers which show the same pinwheel structure, not even among the thousands of faint stars which have been studied with large telescopes. But we should not forget that there are billions of other still fainter stars which have not as yet been investigated. It is likely that the pinwheel structure is not a frequent occurrence in the Universe. We say that it must be an unstable structure, one which rapidly distintegrates and which must relatively soon end. Whether the star loses all of its mass in the process or whether the process stops long before an appreciable fraction of the gases are lost, is not known. Professor Kuiper's theoretical analysis shows that all close double stars must undergo a process of the form described until enough mass is lost to provide for complete clearance of the surfaces of the two stars of all times during their courses around one another. Single stars, like our sun, probably never undergo the pin-wheel stage.

The tidal elongation of the blue supergiant star in β Lyrae renders it appreciably unsymmetrical. In fact, the longest dimension of the star is almost fifty per cent greater than the smallest. It so happens that this star turns around its axis in exactly the same length of time that it takes the yellow star to revolve around it, namely, thirteen days. Hence, the blue star shows always the same side toward the yellow star. But from our location in the solar system we see the elliptical mass of the blue star gradually expose first its long side, then its short, circular cross section, so that the light varies in a continuous manner, exactly as had been suggested several hundred years ago.

Superimposed over this gradual variation in light is the effect of the mutual eclipses of the two suns: the earth happens by chance to lie almost exactly in the plane of the pinwheel. Sometimes the small yellow star is in front of the blue supergiant. We then have an annular or ring eclipse of the latter. A brilliant blue rim remains visible around the relatively dim yellow disc of the secondary component. Then, a little more than three days later, both stars are visible side by side, and we obtain the full benefit of the combined light of the two heavenly bodies. After another interval of three days, or six and one-half days after the beginning, the blue star is in front, and the yellow star is completely eclipsed by the larger disc of the secondary. Nine and three-quarter days after the beginning both stars are again visible with their relative positions reversed and thirteen days later the entire process starts all over again.

THE ADOLESCENCE OF SOCIAL SCIENCE

By Oscar A. Ullrich, Southwestern University

The achievements of the natural sciences viewed in the light of history from the other end may be regarded as miracles. The woman we love may dance in slippers of synthetic leather, wear silk hose made of coal tar, put on a lace dress made of butter milk, spray synthetic rosewater on youthful skin softened to the touch by synthetic vitamins. Artificial diamonds and culture pearls may adorn her fingers and encircle her neck. She may live in a glass house of one-way visibility, air conditioned, dust and germ proof. She may fry germ-conditioned eggs in cotton-seed butter. She may feed Kentucky blue grass rich in vitamins to her baby, and administer "Ersatz" cod liver oil, not unpleasant to the taste. The X-ray may be turned on the body of the infant to see if it actually swallowed the safety pin while the television radio entertains it with Mickey Mouse in technicolor. On holidays the family may glide along the highway in an air conditioned automobile rolling on synthetic rubber doing ninety miles an hour and enjoy the best sermon in the world without feeling annoyed at the collection plate, or it may drift through the cool fresh air of the morning at 400 miles an hour in an aeroplane to enjoy solitude.

These wonder working scientists have made alloys more serviceable than copper and iron in the raw, better than the metals nature gave. Recently, they have invented a super-super microscope, which uses electrons and magnetic fields instead of light rays and lenses for enlarging objects. This magic eye may magnify objects up to 30,000 with such fine detail that photographic enlargements up to 200,000 times life size are possible.[1] A few arithmetical calculations will serve to make clear the significance of this invention. If the average man were magnified 200,000 times, he would be about 214 miles tall and about 56 miles wide across the shoulders. Standing erect he would suffocate for lack of air, and lying prone on the ground, this Gulliver could have his feet in San Antonio and dip his head into the Gulf of Mexico seventy-four miles out from Corpus Christi. With this microscope the biologists will be able to see the whiskers and the fangs on the cold and influenza germs which irritate our noses and throats. No doubt, this invention will lead to discoveries as numerous and as important as those revealed by the simple instrument invented 250 years ago by the Dutch pioneer, Leeuwenhoek.

Even the medicine men have a way of startling us from time to time with their inventions and discoveries. A century ago an amputation of a leg required four strong men to hold the patient while the surgeon sawed the bone. The best anaesthetics known were hypnosis, whisky, and a tap on the head with a wooden mallet. The operation as such was usually successful but the patient often died of complications. Today, major operations even on the brain are undertaken with an amazing nonchalance. Surgeons, when in doubt, may make exploratory operations with every confidence that if nothing is wrong inside no harm is done except perhaps to the pocketbook. What the discoveries in endocrinology may lead to is enough to stagger the imagination. By the proper administration of harmones, biologists have caused some dogs to remain dwarfed while their brothers grew into giants. What is more, they have changed the sex of a hen to that of a rooster and that of a rooster to a hen. In possession of knowledge such as this, biologists of the future may be consulted to make the tall to be short, the fat lean, the brunette blond, and the straight-haired into curly heads. Cosmetics may be applied from within.

The converting of water into wine is hardly more miraculous than the transformation of buttermilk into lace dresses or coal tar into silk stockings. To dream that someday man may be able to make synthetic biscuits by adding liquid air and canned sunshine to mud pies and kneading the mess in a mechanical mixer may not be entirely fantastic. Once the bio-chemist discovers the secret process employed by the wheat plant of combining chemicals from the soil and gases from the air under the influence of sunshine to produce starch, protein, etc., the mechanical engineer will be ready to construct a machine, called, "autobug." Such a contraption may be stopped at any roadside park, mechanical roots plugged into the earth, aerials extended, the proper gears shifted, and hot rolls enjoyed by all. The meal over, the roots and aerials may be contracted, the gears shifted to locomotion, and the family may speed to its destination. Who knows but that the alchemist's dream of converting base metals into gold may not yet come true, especially when we have too much gold already. The bio-psychologist of that day may so mix the harmone elements in us that dull minds become bright and that fear and hate are replaced by love of fellowman.

In comparison with the achievements of the natural sciences, those of the social sciences seem to pale into insignificance. Indeed, critics in increasing numbers have thumbed their figurative noses at our claim to the term science. Others have been so bold as to suggest that the natural sciences take a holiday until the social sciences catch up with them. Of course, no genuine social scientist would wish that to happen. Nonetheless, the social scientist must justify his right to the term science or abandon the claim. Heretofore, the social scientist sought refuge behind the statement that social science is an infant science. Since, however, this science claims to be the brain child of the famous French thinker, Auguste Compte, who between 1830-1842 began to

[1] Davis, Watson, Exploring a New World. Science News Letter, October 12, 1940.

talk about social physics and social dynamics, this argument no longer carries conviction. Sociology is definitely in the throes of adolescence and is trying hard to grow up. Its best defense is to recognize the number and complexity of the variables involved and of the instability of the material with which it works, and to make a frontal attack. A critical comparison of the two fields of work will substantiate these points.

In methodology, the social sciences and the natural sciences are very much alike. Both use the same tests of validity and truth. Cunningham[1] has clearly shown that the two basic criteria of validity are self-evidence and consistency and that the two tests of truth are coherence and utility. He also mentions obviousness but upon closer examination, as he states, this turns out to be merely one aspect of coherence. At the risk of over-simplification, a few illustrations may be in order. The sun is either shining or it is not shining, despite the statements Petrucio makes to Katherine in Shakespeare's "The Taming of the Shrew." As a second example, this well known statement may serve: "You cannot at the same time be here and not here." These two statements are self-evident. Even the hardest headed natural scientist will agree to them. Lawyers frequently make use of the latter formula. They call it "establishing an alibi." The test of consistency involves at least two points, the one dependent upon the other. This may be illustrated by the argument of the excited self-made lawyer representing his first case in court. "If he had a' did what he said he done, he couldn't have saw what he said he seen."

Ignoring grammar, although he was consistent in his errors, this young attorney was employing the principle of consistency. This test will also reveal errors if properly used. Science News Service of November 2, 1940, reports that in the United States a baby is born every thirteen seconds, or an average of 4.6 babies every minute. If Barnum was correct when he stated that a fool is born every minute, it follows according to the law of consistency that about one in five in the United States is a fool; assuming, of course, that other things are equal; namely, that Barnum was referring to the population of the United States and not to that of the world or of Texas, and assuming further that he was able to distinguish a fool from the other kind. From these data one may conclude whether Barnum's statement was valid or invalid.

To determine whether or not a thing is true or false, the criteria of coherence and utility are applied. For example, it is coherent to assert that the principle of the indestructibility of matter implies that soil erosion does not destroy the soil but merely moves it from one place to another. Therefore, the Gulf of Mexico may some day be a fertile valley. In social science, we may with equal certainty assert that monetary inflation does not destroy real values but merely shifts the possession thereof from the "haves" to the "have-nots." The test of utility is simply the answer to the question, does it work? If tying the socks worn during the day around your neck at night wards off colds, you have evidence of their protective value by the test of utility. By this same test it was discovered that quinine cures malaria.

Of course, every scientist is familiar with the methods elaborated by Mills and further enlarged by subsequent scientists. To explain or illustrate, his methods of Enumeration, of Agreement, of Difference, of Joint Method of Agreement and Difference, and of Concomitant Variation would at best only bore you and at worst insult your intelligence as scientists.

As already indicated, the social scientist uses precisely these methods of arriving at the validity of his conclusions and the trueness of his facts. Moreover, in his technique he tries to hold all variables constant except the ones he seeks to study. When possible he drags or coaxes his subjects into a laboratory. But many of the problems to which he must address himself are of such nature that he cannot keep the variables constant nor the subjects confined to a laboratory. The problem of war is one of these. The apparatus and other equipment at his disposal may and usually do differ greatly from those used by the social

[1] Cunningham, G. Watts, Problems of Philosophy (Revised Edition), Henry Holt.

scientist. Shining brass instruments, microscopes, test tubes may be of little use to him whereas they are the essential tools of the natural scientist.

The vast difference between the natural sciences and the social sciences appears in the subject matter under investigation. The materia studied by the natural scientist tend to stay put and yield to controls. This is particularly true in the physical sciences, although less so in the biological sciences. A gas can be imprisoned in a cylinder, pressure can be applied and the change in volume measured. Moreover, the variables are relatively few as compared with problems in social science. Paradoxically, the materia of the social scientist turn out to be non-materia. He seeks to study the human mind as it reveals itself in its reactions to material objects and in its relations to other human minds in their complex behavior. Furthermore, a human act may result from multiple causes rather than from a single cause. The attempt to isolate a possible cause may change the problem or destroy it entirely. Moreover, some human behavior, such as a criminal act, cannot very well be repeated in a laboratory. Sometimes we can perform a social experiment on unsuspecting animals, and by analogy conclude that humans would react in like manner under similar conditions. Dr. Maier[1] of Michigan University, for example, has shown that white rats go crazy, develop tantrums, go into convulsions and otherwise do things no good rat should do, when the experiment is so arranged that everything they do is wrong. Such carrying-on is clearly analagous to the behavior developed in children when they are told, "don't do this," "don't do that," "quit what you are doing and do something else." Lest the natural scientists chide us for using a questionable method, we remind them that they too use the method of analogy, especially in medicine. Many formulae for diet, especially for vitamin therapy are first tried on guinea pigs. If the results seem beneficial, the doses are increased in proportion to body weight and tried on humans.

The difficulty in which the social scientist finds himself may best be shown by the use of an illustration. Suppose we consider a game at billiards. The player drives his cue against a ball. The cue ball impinges on a second ball, and so on. On a level table in good condition, the expert player can foretell what will happen in a long chain of events, which we may term causes and effects. Suppose, however, we endow each ball with intelligence and a will of its own. Remove the billiard player and his stick. Now suppose the cue ball on its own account decides to turn violently against a second ball. But the second ball, seeing his neighbor coming, decides to roll over on one side. In fact all of the balls may decide to roll in different directions. The agitation would be a revolution among billiard balls. Despite the crazy and unpredictable behavior, their movements would be limited and conditioned by the proximity of one to the others, the size of the table, the resiliency of the cushions, as well as the resiliency of their own synthetic ivory bodies. If we endow them with the ability to fly away in space, we merely enlarge the space in which they may move, and thus you complicate the problem. Assuming further for purposes of our illustration, that the billiard balls all have different notions as to direction in which they will move, it becomes obvious that they would bump into one another, and produce chaos. Since they are to be endowed with intelligence, however, the brighter ones among them would discover that there are natural laws in their universe, and furthermore that by conforming to some of these laws all may enjoy unimpinged bodies. Being guided by reason they line up to cooperate one with the other, and by so doing restore order.

Philosophers are not in agreement as to whether all behavior among humans is predetermined and predestined especially in a highly complex situation or whether humans are able to initiate acts irrespective of pre-existing forces resulting from earlier experience. In practice, humans proceed on the assumption that known causes end in anticipated effects. For our purposes, therefore, it suffices to point out that the understanding and the foretelling of human conduct is far more difficult and more subject to error than predicting

[1] Science News Letter, September 23, 1939, page 198.

an occurence in a physics laboratory such as applying a lighted match to a keg of dry powder. Nonetheless, all scientists, including the exacting mathematician, will predict with reasonable accuracy what our neighbor will do if we kick his dog around. Mr. Gallup, by judicial sampling of opinions has prophesied with surprising accuracy the election returns in the presidential election in 1933 and again in 1937. For a similar reason, it does not require supernatural ability for one to predict what will happen if less than fifty percent support the other part of our population while suffrage remains on a man to man basis, particularly if one in ten of the bread earners is on a government payroll. Anyone with average intelligence can predict what will happen to our monetary system when the annual expenditures exceed the annual income plus the interest on the national debt. In the field of Psychology it is now possible to predict with a reasonable degree of accuracy by establishing an intelligence quotient, the chances a given individual has for success in one of several professions.

The illustrations cited demonstrate the fact that social scientists can arrive at valid conclusions, and that these conclusions, which may be dignified as principles, may serve as safe guides in the enactment of laws very much as mathematical formulae serve the engineers in building a bridge. Among the factors necessary for a safe social order are: Honesty, industry, cooperation, and love for our fellowman. Honesty is as necessary for the economic system as the carburetor is for the automobile. As a multi-cylindered machine functions best when all cylinders function smoothly, so society enjoys the greatest welfare when every able bodied adult earns his own keep. The more gamblers and other parasites, the more poverty all around. In a modern complex society cooperation is as essential as harmony in an orchestra. No one of us alone would be able to construct an automobile in a lifetime, to say nothing of drilling a well for the oil and refining it to a high octane value. Only by appropriating the inventions and discoveries of our forerunners and by cooperating with our neighbors are we able to enjoy electric lights, aeroplanes, synthetic medicines, and painless operations.

Why have we failed to bring the benefits of the discoveries and inventions of the natural sciences to all of our people? The answer is that we have not yet learned to love our neighbors as ourselves. Just last week, one of my colleagues told me that on two or three occasions he missed making investments which would have made him financially independent. Obviously, his failure to make the investment resulted in contentment for his neighbor. All the value was still there. In October, 1929, the news flash came one morning that the Americans lost over thirteen billion dollars in the stock market crash in twenty-four hours. Yet on the next day, we had about as many shirts, as many barrels of flour, as many pounds of bacon and beans, and as many automobiles as the day before, less the amounts used in the normal process of consumption. And today, why should any one go naked or shiver in the cold when we have several million bales of cotton in storage? Why should any one go hungry when we have millions of bushels of wheat and corn in our elevators? Why should any one have to walk, when we have on the average one automobile for every family? The answer is, we are selfish and lack a social conscience. To plow under cotton, corn and pigs just because industrialists plow under pig-iron to keep up prices may be scientific but it is not moral. Indeed, it is wicked.

This paper should not be brought to close without calling attention to the fact that what we have said dealt largely with methods and techniques of discovering truths and inventing machines and gadgets for doing things. Clearly, these are all means to an end. Man, the human mind, is the end to be served. This brings us to the most important question of all. What is the aim of life? This question can best be presented by making a few assumptions. Suppose we have eliminated from the earth all of our enemies, both foreign and domestic. Suppose we have solved all of our race problems and are all nordics or what have you. Suppose we embrace one faith and have done with all religious differences. And suppose each of us has an annual income equivalent to $5000.00

and a job or a position assured for the duration of his natural life. What would we do to have abundant life? Or, to put the problem into another frame of thought, suppose all humans should become extinct as the dinosaur, of what value would be the aeroplane, the microscope, a pair of silk hose, a saxophone? If man's destiny is no higher than that of brutes, then we may say with Maxwell Anderson in his recent play "Key Largo," "What the Hell!" Clearly, what society needs, is a worthwhile aim, or a set of worthy aims, in the interest of which our technology is commandeered to serve, much as the horse has been outwitted to serve man. In brief, what America needs most is a nation-wide renaissance, or a heart warming revival.

This revival should consist of three phases. First, the trained intellects of all scientists should make a critical study of all major social problems with the view of determining the wise courses to pursue, keeping in mind the greatest good of all. Second, the educators of every rank, the ministers of the gospel, the statesmen, the radio and the press should inaugurate a campaign not only for the purpose of supplying the reasons for the right courses decided upon but also to begin a system of training designed to open the flood gates of our emotions into the channels of our reason, to the end that we shall desire and act upon that which we know to be wise and right. Such a program involves a stricter disciplining of the youth of the country than the present generation has a stomach for. And third, we must all agree upon a compelling yet satisfying national and perhaps international motif. So far as I can determine, this motif must be of a religious nature. If we cannot eliminate denominational differences, we can at least agree upon a code of ethics which embodies the principle of being a friend to man.

If this paper falls short of the tests of science and appears to be overcharged with emotion, I take comfort in the fact that a famous physicist jumped out of his bath tub shouting to the public "Eureka, Eureka, Eureka." Come over with your knowledge and your gadgets and help us in our attempt to make this a better world in which to live.

COLLEGIATE CONTEST

The Texas Academy of Science, through the generosity of a close friend who prefers that his name be omitted, offered $50 in cash to the members of the Collegiate Division who produced the best papers at our Annual Meeting in San Antonio, November 7, 8, and 9, 1940.

This contest was open to all undergraduate students of the Collegiate Division and was offered to stimulate interest and encourage efforts in this division.

The $50 was divided into three prizes: a first prize of $25, a second prize of $15, and a third prize of $10, for the best, most original, creative or socially useful papers presented.

First Prize: Ross Ney Hayes, Hardin-Simmons University, for "An Improved Vernier Device."

Second Prize: D. C. Thurman, Jr., Texas A. & M., for "Some Pecan Nut Case Bearer Observations During 1940."

Third Prize: June Pike, Incarnate Word College, for "The Calibration of the Photelometer for Practical Use in Clinical and Industrial Laboratories."

AN IMPROVED VERNIER DEVICE

By Ross Ney Hayes, Hardin-Simmons University

Last year the writer became attracted to the idea that anything to be seen with maximum speed and accuracy, and with a minimum of eyestrain, should be represented by either reflected light or transmitted light.

The writer believes that a white object can be seen with greater ease than a black object, and knows that a large part of harmful eyestrain is caused from reading or looking at black objects against a white background. It has been contended that in the case of printed matter the definition would be less with white letters on a black background and therefore the black print on white background would be best due to the better definition. The truth of the matter is that definition entails effort on the part of certain muscles in the eye and the maintenance of that definition is an added source of strain. This is easily proved by analyzing the condition of strain when trying to see the highway in the face of the lights from an oncoming automobile at night. The printed page is a similar condition, the white page comparing to the light and the print the highway.

It was then decided to find a condition in some piece of apparatus to which this contention could be applied. Transmitted light would be used for the purpose of showing how much more could be accomplished by placing the light in proper relation to what is to be done and to the instrument of action.

A vernier seemed to be the best place to attempt proof of the point in question; due to the existence of parallax and a general accentuated condition of eyestrain. So the device was applied to a receiver of the type used for short-wave telegraphic communication where a vernier dial is used for relogging purposes.

In making a scale so that the graduations would be represented by areas of light, several engineering difficulties were encountered. In milling the aperture type graduations in a metal disc there were two main difficulties; that of expense and time expended, and the impossibility of milling a slot less than .015 inch accurately. This width slot was found to be too wide to represent a graduation. Also die stamping of the scales composed of slots in a metal disc at least .025 inch thickness could never approach the necessary narrowness required for the accuracy desired.

In construction of this dial and scales, a piece of transparent material was turned out and centered on a planetary reduction mechanism such as is contained in the National Type A Velvet Vernier dial. The reduction of six to one affords greater ease of setting at the high sensitivity of this scale.

The scales were made by taking a sheet of pure white paper and drawing a circle 22 inches in diameter. Then with a pair of bow dividers the circle was divided in accordance with the scale desired. In this case the scale was two hundred divisions, or one hundred divisions for one hundred and eighty degrees rotation, which is the effective rotation of most variable condensers. The scale was continued to one hundred fifty divisions, or two hundred seventy degrees rotation in case the dial was to be used with a condenser having three-quarters of a revolution effective capacity change.

Then the vernier scale was divided off on a section of a circle equal in diameter to the main circle. This drawing was then taken to a news engraving plant where cuts are made by sensitizing zinc plate with light through a strip film negative. Here use was made of the large camera for reducing purposes.

The negative obtained was cemented to the transparent dial with plastic cement, both negative and dial having been roughened with No. 400 grain emery paper to aid the cement in bonding the negative to the dial. In this way a dial scale of very clean-cut graduations was obtained, and the numbers and lines will be seen to be areas of transmitted light.

As reduction is increased the degree of error in division of the circle is decreased thus making it possible to secure an extremely accurate scale. Also as the width of the lines is reduced with the same reduction, a very fine line or aperture can be obtained on the scale, adding further to the degree of accuracy possible. An extreme high degree of accuracy is insured on such a device as the vernier in this manner.

A further aid to accuracy of setting and ease of operation of this dial is afforded by overlapping the scales. This unique feature causes a solid line of light to appear only at the point where two of the slots are in line; if slightly out of line or completely out of line the solid line of light is broken. In the case of the vernier the pair of lines in registry is instantaneously and precisely located, this making reading of a position or setting to a position extremely easy and rapid.

The possibility of error due to parallax is immensely reduced in this type of dial. With the vernier dial a stroboscopic effect is noticed, created by the lines of the two scales with different spacing ratio consecutively coming into registry. This illustrates the principle involved in a vernier most clearly, for if the vernier scale was extended clear around the periphery there would be ten impulses, each one traveling ten times as fast as the main dial and in the opposite direction. On types of vernier dials other than this one, the ratio of travel and the number of impulses would depend on the ratio of the scales used.

It is hoped that this device will help prove the points concerning eyestrain brought out by the writer in his paper at the Austin meeting last year. It is also hoped that it will find a use for its inherent accuracy and speed on laboratory instruments of various type, and possibly on instruments of a military nature.

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